UGANDA PROTECTORATE.

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ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

YEAR ENDED 31ST DECEMBER, 1932.

(PART II).

PRICE: SHS. 5.

Published by Command of His Excellency the Governor.

ENTEBBE:
PRINTED BY THE GOVERNMENT PRINTER, UGANDA.
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FOREWORD.

This section of the Annual Report of the Agricultural Department deals primarily with experimental work and covers a full cotton year rather than a calendar year. In cotton matters it deals, therefore, with the year ending in May, 1933. It consists of a series of reports under the individual signatures of the officers concerned, and opinions expressed are not necessarily those of Government.

2. Facts about agriculture are often extremely difficult to elucidate because agriculture is not an exact science. Facts none the less lie at the bottom of all our problems, and with the exercise of patience and care extended over a long period of years are apt to come to light. A careful reading of this report will show that progress is being made here and there over the whole field of Uganda agriculture.

3. Particular attention may be drawn to a very few points. The blackarm disease of cotton reduced the crop two years ago by some 70,000 bales of lint, and the Mycologist's report shews that progress is being made in elucidating the factors that enable an outbreak to occur. The reports on cotton breeding work shew, amongst other things, that our standard cotton, N. 17, in the Eastern Province, is shewing signs of deterioration and that other strains are being bred up to replace it; it shews also that the local cotton in Buganda, although still giving good yields, has deteriorated heavily in quality, and that the problem of replacing this cotton in the near future has become a matter of considerable importance; in this connection the selection known as S.G. 23.8 is putting up a good performance record in Buganda, and as the jassid is not of great importance in this area it may prove to be desirable to introduce this strain into general cultivation. The Entomologist's report shews that the pink bollworm has spread south to the Minakulu ginnery area and that it is likely to reach Lango in the near future.

4. With cotton representing the bulk of the wealth produced in and exported from the country, it is obvious that an intelligent forecast of the crop is of considerable value to many interests such as the importing houses at Mombasa in placing forward indents for trade goods, the banks for estimating specie requirements, ginners and lint buyers for making forward arrangements. It is also of value for purposes of estimating the Protectorate revenue.

Such forecasts have now been published for the last three cotton crops with fair success. It is, however, desirable that a more accurate method of estimating should be evolved, and during the year a system of sampling was worked out and put into practice. The results are given as a matter of interest at pages 39 and 40 of the Report of the Botanical Section. It is proposed to try out this system over a period of years, and to improve it in the light of experience. Until proved, however, the results obtained are not being used as the basis for the official estimate.

5. I wish to take this opportunity of expressing my appreciation to all members of the staff who have contributed to this report, also to Sir William Furse, Director of the Imperial Institute; Sir Arthur Hill, the Director of the Royal Botanic Gardens, Kew; Sir William Himbury, the Director of the British Cotton Growing Association; and Sir James Currie, the Director of the Empire Cotton Growing Corporation, for the substantial and most willing assistance they have given at all times.

J. D. TOTHILL,
Director of Agriculture.

ANNUAL REPORT ON THE EXPERIMENTAL WORK CONDUCTED IN THE EASTERN PROVINCE AND LANGO, 1932-33.

INTRODUCTION.

The work of the year is described under five heads :—

Section 1.—Groundnuts.
Section 2.—Cotton.
Section 3.—Coffee.
Section 4.—Maize.
Section 5.—Miscellaneous.

The experiments enumerated in this Report were conducted on the Principal Experiment Farms of Serere and Bugusege, and on the Subsidiary Experiment Farms of Ngetta, Wanyange and Kamuge. In addition, several experiments were conducted on the peculiar soils of Usuku, at Katakwi and Toroma centres.

GENERAL METEOROLOGICAL CONDITIONS.

In general, the weather during 1932 was moderately favourable for all crops. The outstanding features were the unusually dry spells in April and October, and the excessive rainfalls in May, September and December.

SECTION 1—GROUNDNUTS.

SPACING AND MULCHING TRIAL WITH BUNCH AND SPREADING TYPES OF GROUNDNUTS—SERERE.

Objects.—(*a*) To determine the best spacing of 2 ft. by 1 ft., 1 ft. by 1 ft., and 9 ins. by 9 ins.

The closest of these three spacings corresponds roughly to the usual native practice ; in previous spacing trials, 1 ft. by 1 ft. has been the best for the bunch type, and 2 ft. by 1 ft. the best for the spreading type.

(*b*) To test the yield of the bunch type as compared with the spreading type. Hitherto, the former has proved much superior at Serere.

(*c*) To determine the effect of spacing on the incidence of rosette disease.

(*d*) To determine the effect of mulching upon the incidence of rosette disease.

Lay-out.—The experiment consisted of twelve forms of treatment in each of ten random blocks : Three spacings, 2 ft. by 1 ft., 1 ft. by 1 ft., and 9 ins. by 9 ins. Two varieties, bunch and spreading. Two cultivations, mulched and unmulched.

The sub-plots were of uniform size in respect to the area harvested in each.

Spacing.	*No. of Rows*		*Plants per Row*	
	Planted.	*Harvested.*	*Planted.*	*Harvested.*
2 ft. × 1 ft.	20 ...	18 ...	38 ...	36
1 ft. × 1 ft.	38 ...	36 ...	38 ...	36
9 ins. × 9 ins.	50 ...	48 ...	50 ...	48

The harvested area being 36 ft. by 36 ft., or 1/33rd acre in each plot.

The experiment was planted on 26th and 28th April, at one seed per hole. Blanks were supplied on 10th and 11th May, and a mulch of grass applied to the mulched plots on 29th and 30th April and 2nd May.

Results.—

A. Yield.

The plots of the bunch type were harvested on 11th August, and those of the spreading type on 19th September.

Analysis of the yield data gave the following results, expressed as lbs. of unshelled nuts per plot :—

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	9 ...	161·48 ...	0·8112 ...	100 : 1
Spacings	2 ...	3138·67 ...	2·2948 ...	100 : 1
Varieties	1 ...	20·25 ...	0·2269 ...	none.
Mulching	1 ...	0·374 ...	−2·7141 ...	none.
Interactions:				
S. × V.	2 ...	278·34 ...	1·0834 ...	100 : 1
S. × M.	2 ...	6·67 ...	0·7822 ...	none.
V. × M.	1 ...	262·56 ...	1·0542 ...	100 : 1
S. × V. × M. ...	2 ...	135·90 ...	0·7250 ...	20 : 1
Errors	99 ...	31·88		

TABLE FOR THE "LEAST SIGNIFICANT DIFFERENCE" BETWEEN TREATMENT MEANS ($s = 5{\cdot}646$).

	Replications (k).	$\sqrt{\frac{V \times 2}{k}}$	*Least Significant Difference.* 20:1 ($t = 1{\cdot}960$)	100:1 ($t = 2{\cdot}576$).
Spacing	40	1·2625	2·47	3·25
Varieties	60	1·0310	2·02	2·66
Mulching	60			
S. × V. (Whole variance)	20	1·7855	3·50	4·60
S. × M. ,, ,,	20			
V. × M. ,, ,,	30	1·4577	2·86	3·76
S. × V. × M. ,, ,,	10	2·5251	4·95	6·50

TREATMENTS: MEAN PLOT YIELDS (in lbs.).

Spacings :—			*S.* × *V.*—		
9 ins. by 9 ins.	40·09		Bunch	9 ins. by 9 ins.	43·00
1 ft. by 1 ft.	32·64		,,	1 ft. by 1 ft.	33·32
2 ft. by 1 ft.	22·44		,,	2 ft. by 1 ft.	20·09
Varieties :—			Spreading	9 ins. by 9 ins.	37·17
Bunch	32·14		,,	1 ft. by 1 ft.	31·97
Spreading	31·31		,,	2 ft. by 1 ft.	24·79
Mulching :—			*S.* × *M.*—		
Mulched	31·76		Mulched	9 ins. by 9 ins.	39·78
Unmulched	31·69		,,	1 ft. by 1 ft.	33·13
V. × *M.*—			,,	2 ft. by 1 ft.	22·36
Bunch, mulched	33·65		Unmulched	9 ins. by 9 ins.	40·39
,, unmulched	30·62		,,	1 ft. by 1 ft.	32·15
Spreading, mulched	29·87		,,	2 ft. by 1 ft.	22·52
,, unmulched	32·76				

S. × *V.* × *M.*—

Bunch, mulched	9 ins. by 9 ins.	45·89
,, ,,	1 ft. by 1 ft.	35·51
,, ,,	2 ft. by 1 ft.	19·55
,, unmulched	9 ins. by 9 ins.	40·11
,, ,,	1 ft. by 1 ft.	31·12
,, ,,	2 ft. by 1 ft.	20·64
Spreading, mulched	9 ins. by 9 ins.	33·68
,, ,,	1 ft. by 1 ft.	30·75
,, ,,	2 ft. by 1 ft.	25·18
,, unmulched	9 ins. by 9 ins.	40·68
,, ,,	1 ft. by 1 ft.	33·19
,, ,,	2 ft. by 1 ft.	24·41

Conclusions.—(1) *Spacing.*—With the spacings adopted in this trial, yield clearly increases in ascending order of plant population. The spacings adopted do not indicate an optimum population for yield.

(2) *Mulching.*—Considered alone, this treatment has no significant effect on yield.

(3) *Interaction of Spacing and Mulching.*—In this trial mulching is equally without effect at all spacings.

(4) *Variety.*—Over the trial as a whole neither variety shows a significant advantage.

(5) *Interaction of Variety and Spacing.*—This is very significant. The bunch type yields better than the spreading type at 9 ins. by 9 ins. spacing, 1,433 lbs. per acre as against 1,239 lbs. At 1 ft. by 1 ft. spacing there is little to choose between the two types, but at 2 ft. by 1 ft. spacing the spreading type yields 826 lbs. per acre as against 670 lbs. for the bunch type.

(6) *Interaction of Variety and Mulching.*—This is also significant. The bunch type responds well to mulching, yielding 1,122 lbs. per acre over all spacings when mulched, as against 1,021 lbs. when unmulched. At the same time it yields better than the spreading type when mulched, 1,122 lbs. as against 996 lbs. On the other hand, the spreading type yields better over the spacings as a whole when not mulched, 1,092 lbs. against 996 lbs. When not mulched, the spreading type yields better than the bunch type, 1,092 lbs. per acre against 1,021 lbs.

(7) *Combined Interaction of Variety, Spacing and Mulching.*—The response of the bunch type to mulching is above expectation at 9 ins. by 9 ins., and to a lesser extent at 1 ft. by 1 ft. spacing. It derives little benefit from mulching at 2 ft. by 1 ft. spacing, *i.e.*, considerably below expectation. The depressing effect of mulching on the yield of the spreading type is above expectation at 9 ins. by 9 ins. spacing; it fulfils expectation at 1 ft. by 1 ft. spacing; but at 2 ft. by 1 ft. spacing the effect of mulching is hardly noticeable, *i.e.*, the expected depression is not fulfilled.

(8) The variation between blocks is significant, but the error of the experiment is satisfactorily low.

B. SHELLING PERCENTAGE.

Estimated from the weight of kernels obtained from 80 ozs. of unshelled nuts from each sub-plot.

Analysis of the results indicates that the following are significant: Blocks, spacing, variety, and the interaction of variety and mulching (all 100 : 1) and mulching (20 : 1).

TREATMENT MEANS.

Block.			*Varieties.*—		
1	...	72·2	Bunch	...	71·25
2	...	72·8	Spreading	...	72·38
3	...	72·3			
4	...	72·2	*Mulching.*—		
5	...	72·8	Mulching	...	72·25
6	...	72·0	Unmulched	...	71·38
7	...	72·2	*Spacing.*—		
8	...	69·6	9 ins. by 9 ins.	...	72·7
9	...	70·5	1 ft. by 1 ft.	...	71·9
10	...	71·6	2 ft. by 1 ft.	...	70·9

Conclusions.—Although, at first sight, the figures for shelling percentage appeared to be very uniform, on analysis several significant differences emerge.

(1) *Blocks.*—Quite a marked variation in shelling percentage can be attributed to differences in soil fertility.

(2) *Spacings.*—Shelling percentage ascends in the order of plant population, though in this experiment no indication was given of an optimum population.

(3) *Variety.*—The spreading type appears to shell better than the bunch type. This conclusion may not be correct in view of the different harvesting dates (11th August for bunch type and 19th September for spreading type), the different periods of storage before shelling, and the different humidity conditions on the dates of shelling (November 1st was much drier than September 6th).

(4) *Mulching.*—There appears to be a slight difference over the whole experiment in favour of mulching.

(5) *Interaction of Variety and Mulching.*—As before, the bunch type benefits from mulching, while the spreading type is depressed.

C. ROSETTE DISEASE. The following counts were made on the experiment :—

(1) June 4—9. Stand count on all plots over the whole plot, including the edge rows which were not harvested.

(2) July 19—23. Rosette counts on the bunch type, the area harvested in each plot being counted separately from the edge rows.

(3) August 15—16. Rosette counts on the spreading type, the area harvested in each plot being counted separately from the edge rows.

Unfortunately, these counts are widely spaced in time, so that the stand count can hardly be taken to represent the stand at the times when the counts for disease were made. From the results of the rosette counts it was obvious that the incidence of the disease was much heavier on the edge rows. In consequence, it is only justifiable to consider the percentage of disease on the harvested areas ; in any case this is desirable for correlation with yield. It would hardly be correct to calculate the percentage of rosette from the ideal stand (100%), though rosette is certainly responsible for the death of a number of plants. Unfortunately, no separate count is available for the stand of the harvested area. In view of these difficulties the percentage infection has been calculated as below :

$$\frac{\text{No. diseased plants in harvested area} \times 100}{\text{Stand over whole plot.}} \times \frac{\text{Ideal stand over whole plot.}}{\text{Ideal stand over area harvested.}}$$

The above formula assumes that the June stand remained unaltered in July and August, and also that the percentage stand over the whole plot is typical of the stand on the area harvested.

Analysis of the figures thus obtained indicates that the following factors are significant in their influence on the incidence of the disease : Blocks ; spacing ; variety (all 100 : 1).

This is probably due to the earliness of the bunch type (counts were taken a month earlier than those of the spreading type), rather than to any inherent resistance of the bunch type to infection.

(4) Mulching makes no difference to the incidence of disease.

The correlation in the above experiment of percentage rosette and yield, ignoring the effects of stand and spacing, is $-0{\cdot}7358$, which is very significant.

Conclusions.—(1) There is a regional distribution of rosette from block to block, due to edaphic and atmospheric conditions.

(2) Rosette is much less severe at the closer spacings :
9 ins. by 9 ins. ... 7·3%. 1 ft. by 1 ft. ... 15·9%. 2 ft. by 1 ft. ... 33·1%.

(3) The incidence of disease is less on the bunch type :
Bunch ... ... 14·4%. Spreading ... ... 23·1%.

SPACING AND MULCHING TRIAL AT KATAKWI (TESO).

Objects.—To test the effect of mulching on the yield of groundnuts at various spacings.

Lay-out.—The experiment consisted of five random blocks, each containing the following treatments: Spacings—15 ins. by 15 ins., 12 ins. by 12 ins., and 9 ins. by 9 ins. Mulched plots and unmulched plots at each spacing.

Results.—

Treatment Means.			*Block Means.*	
Mulched ...	... 15 ins. ...	24·4	I ...	16·33
„ ...	... 12 „ ...	25·0	II ...	27·83
„ ...	... 9 „ ...	29·8	III ...	19·50
Unmulched	... 15 „ ...	11·6	IV ...	35·83
„ ...	.. 12 „ ...	23·4	V ...	26·17
„ ...	... 9 „ ...	36·6		

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	4 ...	348·08 ...	1·00574 ...	100:1
Spacings	2 ...	634·15 ...	1·30567 ...	100:1
Mulching	1 ...	57·40 ...	0·10454 ...	none.
M. × S.	2 ...	337·10 ...	0·98971 ...	100:1
Error	20 ...	46·57		

Conclusions.—(*a*) The differences in soil fertility as shown by the blocks are very significant in their effect on yield.

(*b*) The differences due to spacing are very significant. Spacing means are: 15-inch 18·0; 12-inch 24·2; and 9-inch 33·2; the least significant difference being 6·40 at 20:1. The 9-inch by 9-inch spacing is significantly better than the wider spacings.

(*c*) Mulching in itself has no effect on the experiment as a whole.

(*d*) The interaction of spacing and mulching is significant. Mulching at 15-inch spacing increases the yield, at 12-inch it makes little difference, and at 9-inch decreases the yield.

SPACING AND MULCHING TRIAL AT TOROMA.

Lay-out.—The experiment was a duplicate of that at Katakwi.

Results.—

Treatment Means.			*Block Means.*	
Mulched ...	... 15 ins. ...	7·2	I ...	10·67
„ ...	... 12 „ ...	9·2	II ...	16·17
„ ...	... 9 „ ...	15·0	III ...	13·50
Unmulched	... 15 „ ...	14·6	IV ...	12·33
„ ...	... 12 „ ...	10·4	V ...	10·00
„ ...	... 9 „ ...	18·8		

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	4 ...	36·13 ...	0·23227 ...	none.
Spacings	2 ...	146·05 ...	0·93069 ...	100:1
Mulching	1 ...	128·10 ...	0·86513 ...	20:1
S. × M.	2 ...	23·35 ...	— ...	none.
Error	20 ...	22·705		

Conclusions.—(*a*) Spacing has a significant effect on yield. Spacing means are: 15-inch 10·9; 12-inch 9·8; 9-inch 16·9; with a least significant difference at 20:1 of 4·47. The 9-inch by 9-inch spacing is thus significantly better than the wider spacings.

(*b*) Mulching has decreased the yield at all spacings to a significant extent.

(*c*) There was no significant interaction between mulching and spacing.

For more detailed statistical analysis these two trials have been combined in the following analysis:—

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Centres	1 ...	2381·4 ...	2·01685 ...	100:1
Blocks	8 ...	192·1 ...	0·75812 ...	100:1
Spacings	2 ...	612·3 ...	1·33773 ...	100:1
Mulching	1 ...	9·6 ...	— ...	none.
S. × M.	2 ...	83·7 ...	0·34274 ...	none.
S. × C.	2 ...	117·9 ...	0·51412 ...	none.
M. × C.	1 ...	160·0 ...	0·66661 ...	none.
S. × M. × C. ...	2 ...	184·0 ...	0·73659 ...	20:1
Error	40 ...	42·173		

Conclusions.—(*a*) The differences due to soil variations at centres and between blocks are very significant.

(*b*) Spacing has a significant effect on yield. Spacing means are: 15-inch 14·45; 12-inch 17·00; and 9-inch 25·05; with a least significant difference at 20 : 1 of 4·194. The 9-inch by 9-inch spacing is better than both the wider spacings.

(*c*) Mulching in itself has no effect.

(*d*) The interaction of mulching, spacing and centres is significant.

The chief differences from expectation are as follows: At Toroma the mulched plots at 15 ins. are below expectation, and the unmulched plots at the same spacing above expectation; at Katakwi the mulched plots at 12 ins. are above expectation, the mulched plots at 9 ins. below expectation, and the unmulched plots at 9 ins. are above expectation.

COUNTS OF ROSETTE DISEASE.

Counts were made on both the preceding trials. Analysis of the results, expressed as percentage of actual stand infected, gives the following:—

A. KATAKWI.

TREATMENT MEANS.

9 ins. × 9 ins.	Mulched	...	17·8%	All 9 ins. × 9 ins. plots	...	19·0%
,, × ,,	Unmulched	...	20·1%	,, 12 ,, × 12 ,, ,,	...	48·1%
12 ins. × 12 ins.	Mulched	...	43·5%	,, 15 ,, × 15 ,, ,,	...	58·0%
,, × ,,	Unmulched	...	54·7%	All Mulched plots	...	39·8%
15 ins. × 15 ins.	Mulched	...	58·3%	,, Unmulched plots	...	44·2%
,, × ,,	Unmulched	...	57·7%			

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	"*Z.*"	"*Significance.*"
Blocks	4 ...	899·79 ...	0·40323 ...	none.
Spacings	2 ...	4177·04 ...	1·17084 ...	100 : 1
Mulching	1 ...	136·11 ...	— ...	none.
S. × M.	2 ...	95·12 ...	— ...	none.
Error	20 ...	401·70		

Least significant difference at 20 : 1 for spacing means is 18·8%; for mulching means, 15·4%.

Conclusions.—(*a*) There is significantly less rosette at 9 ins. by 9 ins. spacing than at wider spacings.

(*b*) Mulching makes no difference to the relative incidence of rosette disease.

B. TOROMA.

TREATMENT MEANS.

9 ins. × 9 ins.	Mulched	...	13·2%	All 9 ins. × 9 ins. plots	...	10·7%
,, × ,,	Unmulched	...	8·2 %	,, 12 ,, × 12 ,, ,,	...	19·7%
12 ins. × 12 ins.	Mulched	...	21·0%	,, 15 ,, × 15 ,, ,,	...	19·7%
,, × ,,	Unmulched	...	18·4%	All Mulched plots	...	21·5%
15 ins. × 15 ins.	Mulched	...	30·3%	,, Unmulched plots	...	17·4%
,, × ,,	Unmulched	...	26·0%			

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	"*Z.*"	"*Significance.*"
Blocks	4 ...	268·74 ...	0·87343 ...	20 : 1
Spacings	2 ...	715·10 ...	1·36275 ...	100 : 1
Mulching	1 ...	117·61 ...	0·46023 ...	none.
S. × M.	2 ...	3·88 ...	— ...	none.
Error	20 ...	46·848		

Least significant difference between spacing means is 6·43%.

Conclusions.—(*a*) The 9 ins. by 9 ins. spacing has less disease than the 12 ins. by 12 ins., which is itself better than the 15 ins. by 15 ins. spacing, *i.e.*, the incidence of the disease increases as the population decreases.

(*b*) Mulching makes no difference to the incidence of rosette.

C. COMBINED ANALYSIS OF THE ROSETTE COUNTS AT TOROMA AND KATAKWI.

For greater accuracy the counts were combined in a single analysis with the following results:—

Conclusions.—(*a*) There was significantly more rosette at Katakwi than at Toroma.

(*b*) Differences in position and soil factors, as between the various blocks of the experiments, have a significant effect on the amount of disease at 20 : 1.

(*c*) Spacing is very significant in its effect on the incidence of the disease. Spacing means: 9 ins., 14·84; 12 ins., 34·42; 15 ins., 44·2. Least significant difference is 9·73%.

(*d*) Mulching has no effect on the incidence of disease.

(*e*) There are no significant interactions between spacing, mulching, and centres.

SPACING AND MULCHING TRIAL AT KAMUGE FARM.

The design of this experiment was the same as that at Katakwi and Toroma.

Conclusions.—(1) *Rosette Disease.*—During the early stages, when the disease was in the localised stage, rosette was more severe on the mulched plots. Later, when the disease became general, mulching had the effect of reducing further incidence of disease.

(2) *Yield.*—The 15 ins. by 15 ins. spacing was inferior to the two closer spacings. The yields were very poor (averaging only 333 lbs. per acre) and the general effect of rosette, together with that of poor soil, appears to have had so great an influence on yield that the differential effects of spacing and mulching on yield were not very evident.

The experiment indicated that 12 ins. by 12 ins., or closer, is the better spacing for spreading groundnuts, and that the effect of mulching is not significant, though the mulched plots gave a better yield than the unmulched (139 lbs. against 125½ lbs.).

SPACING AND MULCHING TRIAL AT WANYANGE PLANTATION.

The lay-out of the experiment was the same as that at Katakwi, Toroma and Kamuge, except that the bunch variety only was used here.

Results.—

A. YIELD (in lbs. of shelled nuts).

TREATMENT MEANS.

	15 ins. by 15 ins.	*12 ins. by 12 ins.*	*9 ins by 9 ins.*	*Mean.*
Mulched	23·6	21·8	29·0	24·8
Unmulched	23·2	24·2	28·4	25·3
Means	23·4	23·0	28·7	25·03

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	4	49·03	0·70257	20 : 1
Spacings	2	101·24	1·06506	100 : 1
Mulching	1	1·63	—	none.
S. × M.	2	7·04	—	none.
Error	20	12·03		

Conclusions.—(*a*) The 9 ins. by 9 ins. spacing is significantly better than the wider spacing (least significant difference is 3·26 lbs.).

(*b*) Mulching had no effect on yield.

(*c*) Differences in the soil fertility between the blocks are reflected in significant differences in yields.

(*d*) There is no interaction between spacing and mulching.

B. ROSETTE DISEASE (as % stand infected).

Results.—

TREATMENT MEANS.

	15 ins. by 15 ins.	*12 ins. by 12 ins.*	*9 ins by 9 ins.*	*Mean.*
Mulched	2·53	4·90	1·38	2·94
Unmulched	4·20	2·01	1·19	2·47
Means	3·37	3·46	1·29	2·70

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	4	11·8596	0·45318	none.
Spacings	2	15·0724	0·57354	none.
Mulching	1	1·6474	—	none.
S. × M.	2	13·0733	0·50178	none.
Error	20	5·9501		

Conclusions.—There are no significant effects on the incidence of the disease due to spacing, mulching or differences in soil fertility.

SPACING AND BROADCASTING TRIAL AT NGETTA.

Objects.—(*a*) To determine the best spacing of 2 ft. by 1 ft., 1 ft. by 1 ft., and 9 ins. by 9 ins.

(*b*) To determine whether or not spacing the plants is better than broadcasting an equivalent amount of seed.

(*c*) To determine the effect of mulching plants spaced 1 ft. by 1 ft.

Lay-out.—The experiment consisted of seven forms of treatment in each of five random blocks : Three spacings ; 2 ft. by 1 ft., 1 ft. by 1 ft. and 9 ins. by 9 ins. Three broadcast plots with seed rates equivalent to the above spacings. One plot spaced 1 ft. by 1 ft. and mulched

Results.—

A. YIELD (in lbs. of unshelled nuts).

ANALYSIS OF VARIANCE (ALL TREATMENTS).

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	4	129	0·933	100 : 1
Treatments	6	129	0·933	100 : 1
Error	24	20		

Least significant difference between means for treatments : At 20 : 1—5·8 ; at 100 : 1—7·9.

TREATMENT MEANS.

Spaced 2 ft. × 1 ft.	43·0.	Broadcast (2 ft. × 1 ft.)	39·0.
Spaced 1 ft. × 1 ft.	50·6.	Broadcast (1 ft. × 1 ft.)	43·6.
Spaced 9 ins. × 9 ins.	53·6.	Broadcast (9 ins. × 9 ins.) ...	47·0.
		Mulched 1 ft. × 1 ft.	49·8.

Conclusions.—(*a*) The closer spacings of 1 ft. by 1 ft. and 9 ins. by 9 ins. are better than 2 ft. by 1 ft.

(*b*) The closer spacings are better than the corresponding broadcasts.

(*c*) There is no advantage in mulching.

Analysis of the above results omitting the mulched plots indicates that :

(*a*) Sowing in rows is better than sowing broadcast.

(*b*) 1 ft. by 1 ft. and 9 ins. by 9 ins. are better than 2 ft. by 1 ft.

(*c*) There is no interaction between spacing and sowing methods.

B. Rosette Counts.

Unfortunately, no count was possible of the final stand in each plot of the experiment. Counts of the number of rosetted plants were made at monthly intervals, and analysis of the last count made gives the following results, the counts being given as a percentage of the ideal stand in each plot :

Treatment Means.

Spaced 2 ft. × 1 ft.	8·24.	Broadcast 2 ft. × 1 ft.	6·24.
Spaced 1 ft. × 1 ft.	4·36.	Broadcast 1 ft. × 1 ft.	2·64.
Spaced 9 ins. × 9 ins.	1·76.	Broadcast 9 ins. × 9 ins.	0·82.

Spacing Means.

2 ft. × 1 ft.	1 ft. × 1 ft.	9 ins. × 9 ins.
7·24.	3·50.	1·29.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	" *Z.*"	" *Significance.*"
Blocks	4	6·809	—	—
Spacing	2	90·457	1·07399	100 : 1
Sowing methods	1	16·096	—	none.
S. × S	2	1·754	—	—
Errors	20	10·558		

Least significant difference between spacing means at 20 : 1 is 3·05, and at 100 : 1 is 4·18.

Conclusions.—(*a*) The incidence of the disease is less severe at close spacings.

(*b*) There is no advantage to be gained by sowing in rows over broadcast.

Note :—The above calculations do not include the mulched plots. Analysis of the counts on these latter, when combined with those from the corresponding spacing and broadcast, indicates that there is no difference between the three series of plots in incidence of disease.

VARIETY TRIAL AT SERERE.

Varieties used.—Bunch type, mass selected, 1929. Bunch type, mass selected, 1930 " Pinto's bar." Spreading type, mass selected, 1930. Spreading type, ordinary seed.

Lay-out.—A five by five Latin square, the harvested area of each plot being 1/30th acre.

Results.—Yield (in lbs. of Unshelled Nuts) :—

Treatment Means.

Bunch type, Mass Selected, 1929	35·7
Bunch type, Mass Selected, 1930	36·0
" Pinto's Bar "	36·3
Spreading type, Mass Selected, 1930	33·7
Spreading type, ordinary seed	36·8

Results.—There was no significant difference between any of the varieties used. Counts for rosette disease were made on these plots and gave the following result :—

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	" *Z.*"	" *Significance.*"
Rows	4	86·1	—	—
Columns	4	187·1	—	—
Varieties	4	336·8	0·748	20 : 1
Error	12	75·46		

Least significant difference between variety means is 12·0.

Variety Means (% infection).

(*a*) Bunch, Mass Selected, 1929	5·9
(*b*) Bunch, Mass Selected, 1930	6·2
(*c*) " Pinto's Bar "	17·2
(*d*) Spreading, Mass Selected, 1930	25·4
(*e*) Ordinary Spreading	15·5

Conclusion.—Variety (*d*) has more disease than (*a*) and (*b*). This may be due to the longer growing season of the spreading types as compared with the bunch types, and not to any inherent resistance of the latter.

COMPARISON OF BUNCH AND SPREADING TYPES AT NGETTA.

These two types were compared at two spacings, 9 ins. by 9 ins. and 15 ins. by 15 ins., the experiment being laid out in the form of five random blocks of four plots each.

Results.—YIELD (in lbs. of Unshelled Nuts):—

TREATMENT MEANS.

Bunch, 9 ins. by 9 ins.	23·6	Bunch type	19·2
Bunch, 15 ins. by 15 ins.	14·8	Spreading type	32·9
Spreading, 9 ins. by 9 ins	36·2	Spacing, 9 ins. by 9 ins.	29·9
Spreading, 15 ins. by 15 ins.	29·6	Spacing, 15 ins. by 15 ins.	22·2

The experiment was planted on the 25th April, 1932. Growth was satisfactory until the second week in June, when a dry spell set in which continued into the latter half of July. The bunch type was harvested towards the end of July, and it suffered severely from the drought. The spreading type was not harvested until early September.

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	"*Z.*"	"*Significance.*"
Blocks	4 ...	23 ...	— ...	—
Varieties	1 ...	938 ...	2·081 ...	100:1
Spacings	1 ...	296 ...	1·505 ...	100:1
Interaction V. × S. ...	1 ...	7 ...	— ...	—
Error	12 ...	14·6		

Conclusions.—(*a*) Spreading type yielded better than the bunch.

(*b*) The closer spacing yielded better than the wider.

(*c*) There is no interaction between variety and spacing in this experiment.

VARIETY TRIAL No. 2. (MINIATURE) AT SERERE.

The following varieties were used in a five by five Latin square, each plot (harvested area) being 1/680th acre. 1 ft. by 1 ft. spacing was used in all plots.

Varieties.—African, Spanish, Virginia Bunch from South Africa, Virginia Red and No. 68/6 Spanish selection.

Results.—*A.* YIELD (in ozs. per plot).

VARIETY MEANS.

African	36·6
No. 68/6	27·4
Virginia Bunch	38·8
Spanish	32·4
Virginia Red	26·4

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	"*Z.*"	"*Significance.*"
Rows	4 ...	39·2 ...	— ...	—
Columns	4 ...	12·2 ...	— ...	—
Varieties	4 ...	149·5 ...	1·286 ...	100:1
Error	12 ...	11·4		

Conclusions.—African and Virginia Bunch yielded better than the other varieties (least significant difference is 6·5 ozs.).

B. INCIDENCE OF ROSETTE.

Analysis of the counts for rosette disease on the above experiment indicated that there was no significant difference in the percentage infection on the five varieties, though the two varieties with the highest yield showed the lowest amount of infection.

VARIETY TRIAL AT WANYANGE.

Object.—To compare the yields of the spreading and the bunch types.

Lay-out.—Five pairs of plots, arranged at random, each 1/33rd of an acre.

Result.—MEAN YIELD, per plot, of shelled nuts: Bunch variety, 38·4 lbs.; Spreading variety, 18·8 lbs.

Conclusion.—In this experiment the bunch type gave almost twice the yield of the spreading type (very significant by the "z" test); this may be due in part to the fact that the experiment was sown much later than is customary in this district, which would tend to affect the yield of the spreading type with its longer growing season, more than the bunch type.

VARIETY TRIAL AT KAMUGE.

Object.—To compare the yields of the spreading and bunch types.

Lay-out.—Eight random pairs of plots, each 20 ft. by 82 ft.

Result.—MEAN YIELD, per plot: Bunch, 6·325 lbs.; Spreading, 4·800 lbs.

Conclusion.—The bunch type is superior in yield to the spreading type, and the difference is very significant (100 : 1). Rosette counts indicated that the bunch type was more resistant than the spreading.

The average yield per acre was only 135 lbs., due to poor soil, the land used having been cultivated for a number of years. In native practice groundnuts are planted on land reclaimed from bush.

EXPERIMENT TO TEST THE EFFECT OF ROGUING ROSETTE DISEASE—SERERE.

Lay-out.—Ten plots in random pairs—rogued and control.

The spreading type of groundnut was used, planted 12 ins. by 12 ins. The plots were 32 ft. by 32 ft. with a ten-foot belt of guinea corn as a screen around each plot. The plots were planted on 9th May, and weekly roguings were made up to 15th July.

Results.—(1) There was no significant difference in percentage rosette infection at harvest between the rogued plots and the control plots.

(2) There was no significant difference in yield per plant between the two treatments although the final stand in the control plots averaged 60 plants more than in the rogued plots. It would be expected that the wider spacing of the final stand in the rogued plots would result in a higher yield per plant.

NOTE.—In this experiment, an average of 36 plants per plot were rogued out on account of rosette infection ; the final infection in the rogued plots was 16 per cent. It is probable that the roguing was not carried out efficiently ; on the other hand, had a larger percentage of plants been rogued, it is probable that infection in the remainder would have become higher during the interval before harvest, as the incidence of disease becomes greater as the spacing becomes wider.

GROUNDNUTS—SUMMARY OF ALL RESULTS OBTAINED IN 1932.

A. SPACING.

The four spacings used in these experiments were 2 ft. by 1 ft., 15 ins. by 15 ins., 12 ins. by 12 ins., and 9 ins. by 9 ins. In general, yield increases with the closer spacings, but in these experiments no indication was obtained of an optimum spacing. For this reason, still closer spacings will be used in the 1933 trials.

The incidence of rosette disease is definitely lighter at the closer spacings.

At close spacings there is indication that the bunch type yields better than the spreading, but at wider spacings this order is reversed.

B. MULCHING.

Considered as a whole, mulching has no effect upon yield or on the incidence of disease. On the other hand, at Serere the bunch type responds well to mulching, although the increase in crop obtained thereby (100 lbs. per acre) is not sufficient to defray the additional cost.

C. VARIETY.

In this series of experiments the bunch type proved superior in yield to the spreading at Wanyange and Kamuge. In general, the incidence of rosette is less on the bunch than on the spreading type.

D. COMPARISON WITH NATIVE PRACTICE.

The usual native practice of groundnut cultivation is to sow broadcast, at a heavy seed rate per acre, to obtain a close stand ; in addition, weeds are allowed to grow on the plots. At Ngetta, we have indications that close spacing in rows is preferable to broadcast sowing.

In general, it appears from the results of these experiments that the ideal practice is to obtain a close cover of the soil from the viewpoint of both yield and avoidance of disease. The present native practice is a close approximation to this ideal although close spacing in rows might result in an additional advantage over broadcast sowing.

The results of experiments carried out previous to 1932 indicated that the bunch type yields better than the spreading. It also matures roughly six weeks earlier than the spreading. On the other hand it is susceptible to attack by locusts. In certain areas it is customary to plant groundnuts in April. In such areas the bunch type will be ready for lifting in late July, at a time when the natives are mainly occupied in the planting of cotton. From this point of view the early maturing properties of the bunch type might prove disadvantageous.

SECTION 2—COTTON.

SPACING AND SEED RATE TRIAL—SERERE.

Object.—To determine the best spacing of 4 ft. by 1½ ft. and 3 ft. by 1 ft., in June and July sowings ; also to determine the number of seeds per hole (3, 6, 9 or 12) required to give the best stand and yield.

Lay-out.—Two sowing dates, two spacings, and four seed rates—sixteen treatments, replicated in each of eight random blocks. For convenience, each block was sub-divided into two sub-blocks, one for each spacing, the other treatments being scattered within the sub-blocks at random.

The experiment was sown on 1st June and 1st July.

Results.—A. PERCENTAGE OF BLANKS.

		TREATMENT MEANS.		
June sowings	23·7	Three seeds per hole	33·7
July sowings	16·7	Six seeds per hole	18·9
4 ft. by 1½ ft. spacings	19·6	Nine seeds per hole	14·1
3 ft. by 1 ft. spacings	20·5	Twelve seeds per hole	13·4

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Spacing sub-blocks ...	15			
Spacing	1 ...	30·0 ...	— ...	none.
Blocks	7 ...	81·67 ...	— ...	—
Error (*a*)	7 ...	39·18		
Total	127			
Sub-blocks	15			
Seed/hole	3 ...	1714·7 ...	1·79199 ...	100:1
Sowing dates	1 ...	1725·8 ...	1·80020 ...	100:1
Spacing × S.D. ...	1 ...	57·8 ...	— ...	none.
Spacing × seed rate ...	3 ...	10·9 ...	— ...	none.
S.D. × S.R.	3 ...	215·8 ...	0·76062 ...	100:1
S. × S.R. × S.D. ...	3 ...	73·5 ...	— ...	—
Error (*b*)	98 ...	47·14		

Results.—B. YIELD IN OZS. OF SEED COTTON.

TREATMENT MEANS.

June sowings	49·2	Three seeds per hole	50·6
July sowings	48·5	Six seeds per hole	49·3
4 ft. by 1½ ft. spacings	48·3	Nine seeds per hole	48·2
3 ft. by 1 ft. spacing	49·3	Twelve seeds per hole	47·1

Analysis of these results indicates that there are no significant differences in this experiment.

Conclusions.—(*a*) The stand from the July sowing was significantly better than that from the June sowing.

(*b*) There is no significant difference between the 4 ft. by 1½ ft. and 3 ft. by 1 ft. spacings.

(*c*) Nine and twelve seeds per hole gave similar stands, both being significantly better than six seeds per hole, the latter being significantly better than three seeds per hole.

(*d*) The interaction between seed rate and sowing date is significant.

SOWING DATE AND SPACING TRIAL—WANYANGE.

Objects.—To determine the best of the following sowing dates—9th June, 30th June, 21st July, 11th August, 1st September and 22nd September, and the better of the two spacings, 3 ft. by 1 ft. and 4 ft. by 1½ ft.

Lay-out.—Five randomised blocks were used, one plot at each spacing being sown in each block on each of the above dates.

Results.—

TREATMENT MEANS.

	9th June.	*30th June.*	*21st July.*	*11th August.*	*Mean.*
3 ft. by 1 ft. ...	15·9 ...	14·0 ...	10·8 ...	4·5 ...	11·3
4 ft. by 1½ ft.	14·9 ...	12·2 ...	11·2 ...	4·1 ...	10·6
Means ...	15·44 ...	13·08 ...	11·00 ...	4·30 ...	10·95

NOTE.—No cotton was picked from the two sowings in September, so these have been discarded in the following analysis:

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"Z."*	*"Significance."*
Blocks	4 ...	13·9713 ...	— ...	—
Spacings	1 ...	4·8094 ...	— ...	—
Sowing Dates ...	3 ...	229·6002 ...	1·91793 ...	100:1
Spacing × S.D. ...	3 ...	2·2271 ...	— ...	—
Error	27 ...	4·9557		

Conclusions.—(*a*) There is no significant difference between the two spacings used in this experiment.

(*b*) There is no interaction between sowing date and spacing.

(*c*) The differences between the means for the sowing dates are significant (least significant difference is 2·04 lbs.). There is a progressive reduction in yield as the date of sowing is postponed during the season, until September; the yield from the sowings made in this month being nil.

SOWING DATE AND SPACING TRIAL—NGETTA.

Lay-out.—Two spacings were used in this experiment, 3 ft. by 1 ft. and 4 ft. by 1½ ft.

The following were the sowing dates: 21st May, 4th June, 18th June, 2nd July, 16th July and 30th July. The harvested area of each plot was 24 ft. by 39 ft. and the experiment was arranged in ten random blocks of twelve plots each.

Results:—

YIELD TOTALS FOR EACH TREATMENT.

	21st May.	*4th June.*	*18th June.*	*2nd July.*	*16th July.*	*30th July.*
3 ft. by 1 ft.	63 ...	70 ...	62 ...	76 ...	71 ...	51
4 ft. by 1½ ft.	67 ...	75 ...	59 ...	63 ...	59 ...	39

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	"*Z.*"	"*Significance.*"
Total	119			
Blocks	9	6·0	0·896	100:1
Spacings	1	8·0	0·693	20:1
Sowing Dates ...	5	18·8	1·121	100:1
Spacing × S.D. ...	5	3·6	0·295	none.
Error	99	2·0		

The least significant difference between sowing date totals is 35·77.

STAND COUNT, 17TH JANUARY, TOTALS FOR TREATMENTS.

	21st May.	*4th June.*	*18th June.*	*2nd July.*	*16th July.*	*30th July.*
3 ft. by 1 ft. ...	1,144	1,243	1,060	1,209	1,479	1,169
4 ft. by 1½ ft ...	459	556	466	643	706	543
Total	1,603	1,799	1,526	1,852	2,185	1,712

NOTE.—The possible stands are, for 3 ft. by 1 ft., 3,600 plants for each sowing date, and for 4 ft. by 1½ ft., 1,890 plants.

YIELD PER PLANT—(In lbs.).

21st May.	*4th June.*	*18th June.*	*2nd July.*	*16th July.*	*30th July.*
0·081 ...	0·081 ...	0·079 ...	0·075 ...	0·059 ...	0·053

Conclusions.—(*a*) Over the range of sowing dates, 3 ft. by 1 ft. spacing gives a better yield than 4 ft. by 1½ ft.

(*b*) There are significant differences between the yields from the different sowing dates; although the total yields show no definite trend, this is owing to differences in stand, and the yield per plant decreases when sown after June 4th.

(*c*) The interaction of spacing and sowing date is not significant, though there is an apparent advantage to closer spacing later in the planting season.

SPACING EXPERIMENT WITH LATE COTTON—NGETTA.

Object.—To compare the yields of late planted cotton at the following spacings:

A. 1 ft. by 1 ft. *B.* 2 ft. by 1 ft. *C.* 3 ft. by 1 ft.

Lay-out.—Six random blocks of three plots each; the harvested area of each plot was 30 ft. by 30 ft.

Results.—The experiment was planted on 10th August and the stand obtained on all plots was moderately good. The plants in the plots spaced 1 ft. by 1 ft. grew tall, straight and spindly, and were noticeably lacking in fruit. The cotton was too late to produce a second crop in the season, though the second flowering flush was prolific.

TOTAL YIELDS (lbs. of seed cotton).

A. 1 ft. by 1 ft. ... 51. *B* 2 ft. by 1 ft. ... 53. *C.* 3 ft. by 1 ft. ... 53. TOTAL ... 157.

Analysis of the results obtained indicates that there was no significant difference between the yields obtained from the three spacings.

INTER-PLANTING EXPERIMENT WITH COTTON AND GROUNDNUTS—NGETTA.

Lay-out.—The experiment consisted of three treatments as follows, replicated five times in random blocks:

A. Cotton, 4 ft. by 1 ft., inter-planted with one row of groundnuts.
B. Cotton alone, 4 ft. by 1 ft.
C. Groundnuts alone, 1 ft. by 1 ft.

The cotton was sown late, on 15th July, and the groundnuts later, on 8th August. The groundnuts failed noticeably when planted between the rows of cotton.

Results.—YIELDS (in lbs. of seed cotton and lbs. of unshelled nuts):

TOTAL *C.* Groundnuts alone ... ... 174 lbs.
B. Cotton alone ... ... 165 lbs.
A. Groundnuts and cotton ... 28 lbs. groundnuts and 155 lbs. cotton.

Conclusion.—The yield of groundnuts was entirely spoilt by interplanting, but that of cotton was hardly affected.

The plots were 25 ft. by 12 ft. and the average yields were:

B. Cotton alone ... 479 lbs. per acre. *C.* Groundnuts alone ... 505 lbs. per acre.

The following experiments were carried out at Katakwi and Toroma, but the results on analysis were found to be indefinite or doubtful:

(*a*) Spacing Trials
(*b*) Sowing Date Strips.
(*c*) Ridge versus Flat Cultivation.
(*d*) Break-pan Experiment. Also—
(*e*) Sowing Date Trial at Kamuge.

SECTION III—COFFEE.

PRUNING EXPERIMENT—BUGUSEGE.

Object.—To compare the yields obtained from coffee pruned on the Single Stem, Multiple Stem and Agobiada systems.

Lay-out.—Eight random blocks of three plots each ; each sub-plot contains seven rows of eight trees at 8 ft. by 8 ft. spacing.

Results.— The mean yield over the whole experiment during 1932 was 865·46 lbs. of cherry per plot, which is over four times the yield of the previous season, and nearly twice that of the 1930 crop.

For this reason the following table has been calculated, showing the mean yields of the three treatments since the commencement of the experiment ; for each season the yield is expressed as a percentage of the mean for the whole experiment for that season.—

Year.	*Single Stem.*	*Multiple Stem.*	*Agobiada.*
1929	126·375 ...	88·375 ...	85·25
1930	82·375 ...	92·875 ...	124·50
1931	40·875 ...	48·875 ...	211·125
1932	76·375 ...	92·875 ...	131·25
Mean, 1929-32 crops	81·500 ...	80·750 ...	138·030

Analysis of the yields over the four crops so far harvested is as follows :—

	Degrees of Freedom.	*Sum of Squares.*	*Variance.*	*"Z."*
Total	92* ...	272,235·16 ...	— ...	—
Blocks	7 ...	16,623·57 ...	2,374·80 ...	0·41876
Pruning Systems ...	2 ...	69,093·19 ...	34,546·60 ...	1·75749
Pruning System × Season	6 ...	107,333·96 ...	17,888·99 ...	1·42840
Error	77 ...	79,184·44 ...	1,028·37 ...	—

* 95 *less* 3 for the extraction of four seasons' means.

The least significant difference between the above treatment means for the four seasons combined is 16·32%.

Conclusions.—The Agobiada system of pruning has given the highest yield over the four seasons ; there is no significant difference between the yields obtained from the Single Stem and Multiple Stem systems.

The interaction of pruning system and season is significant ; the order of the systems with rega d to yield in the first season has been reversed in the succeeding three seasons ; the Agobiada system yielded much better than expectation in 1931.

MANURING EXPERIMENT—BUGUSEGE.

Objects.—To compare the yields from coffee manured in the following ways :—

(*a*) Clean weeded.
(*b*) Green manure—two covers per annum.
(*c*) Banana leaf mulch.
(*d*) Ordinary weed cover.
(*e*) Leguminous cover crop from October to March, and clean weeded for the rest of the year.

Lay-out.—The experiment was planted in 1928 as a five by five Latin square. Each sub-plot contains five rows of eight trees each, planted 8 ft. by 8 ft. The trees are pruned on the Single Stem system on all plots, modified with a view to prevention of die-back by allowing unlimited terminal growth.

Results.—The 1932 crop gave a mean yield of 324·72 lbs. of cherry from each plot. The following table shows the yield obtained from each treatment in the three crops harvested since the experiment was commenced. The yields are expressed as a percentage of the mean yield over the whole experiment for the respective seasons.

Treatment	*1930.*	*1931.*	*1932.*	*Mean.*
(*a*) ...	101·0 ...	114·8 ...	82·8 ...	99·53
(*b*) ...	97·8 ...	89·2 ...	105·6 ...	97·53
(*c*) ...	89·6 ...	110·0 ...	122·0 ...	107·20
(*d*) ...	109·4 ...	72·2 ...	61·8 ...	81·13
(*e*) ...	102·0 ...	114·4 ...	127·6 ...	114·67

Analysis of the results obtained so far from this experiment gives the following :—

	Degrees of Freedom.	*Sum of Squares.*	*Variance.*	*"Z."*
Total	72* ...	50,150·99 ...	— ...	—
Rows and Columns ...	24 ...	16,438·72 ...	684·95 ...	0·41587
Treatments	4 ...	9,438·05 ...	2,359·513 ...	1·03405
Treatments × Seasons	8 ...	13,533·71 ...	1,691·714 ...	0·86771
Error	36 ...	10,740·51 ...	298·35 ...	—

* 74 *less* 2 for the extraction of three seasons' means.

The least significant difference between the above treatment means for the three crops combined is 12·87%.

Conclusions.—Treatment (*d*)—The ordinary weed cover is significantly the worst of the five treatments of this experiment.

Treatment (*e*)—A leguminous cover crop from October to March, and clean weeded for the rest of the year, is significantly better than treatments (*a*), (*b*) and (*d*).

The other differences between treatments are not significant.

The interaction of treatments and seasons is very significant, largely owing to the progressive increase in crop production in treatments (*c*) and (*e*) and to the decline in treatment (*d*).

PRUNING EXPERIMENT No. 2—BUGUSEGE.

Object.—To test (*a*) a single form of multiple stem pruning, which might be applicable to native practice, against (*b*) natural growth, and (*c*) Agobiada.

Results.—The first crop was harvested during the year under review. It was so small that analysis was not worth while.

NEW EXPERIMENTS—BUGUSEGE.

(*a*) *Manuring Experiment No. 2.*—This is a repetition of manuring experiment No. 1, with the addition of treatments (*f*) banana stem mulch, and (*g*) *Leucaena glauca* cover. Planting of this experiment was completed in 1932 and all trees are pruned on a modified multiple stem system.

(*b*) *Spacing Experiment.*—This experiment was planted in 1932 to test the following spacings : 4 ft. by 4 ft., 6 ft. by 6 ft., 7 ft. by 7 ft., and 8 ft. by 8 ft.

Two pruning systems are used for each of these spacings, *viz.*, natural growth and a modified multiple stem.

(*c*) *Shade Experiment.*—Planted in 1932 to test the following treatments : (*a*) No shade. (*b*) Permanent shade. (*c*) Temporary shade, removed one month before flowering. (*d*) Temporary shade, removed two months before flowering. (*e*) Temporary shade, romoved three months before flowering.

(*d*) *Single Tree Yield Experiment, 1932.*—200 trees were planted to determine the variation in yield between individual trees, with the object of ascertaining the minimum number of trees required per sub-plot of coffee experiments to give reliable results.

SECTION IV—MAIZE.

VARIETY TRIAL—SERERE.

The three varieties, Hickory King, Wisconsin and Flat White, were used in this trial, which consisted of ten random blocks of three plots each. The area harvested was 1/40th acre for each plot.

Variety Means.—Wisconsin, 79·8 lbs. (3,190 lbs. per acre).
Hickory King, 81·5 lbs. (3,261 lbs, per acre).
Flat White, 97·5 lbs. (3,899 lbs. per acre).

Analysis of variance of the plot yields obtained indicates that there is no significant difference between the yields of the three varieties.

Spacing Experiment with One and Two Plants per Hole.

Objects.—To determine the best spacing of 3 ft. by 2 ft., 3 ft. by 1 ft. and 2 ft. by 1 ft. 9 ins. To determine whether one or two plants per hole gives the best yield.

Lay-out.—Six treatments in ten random blocks. Three spacings : 3 ft. by 2 ft., 3 ft. by 1 ft., 2 ft. by 1 ft. 9 ins., each with one and two plants per hole.

Variety used.—Hickory King.

Results.—

A. Number of Cobs per Plot.

	Treatment Means.			
	3 ft. by 1 ft.	*3 ft. by 2 ft.*	*2 ft. by 1 ft. 9 ins.*	*Mean.*
One plant per hole ...	475·6 ...	375·7 ...	422·5 ...	424·6
Two plants per hole ...	578·9 ...	475·0 ...	547·8 ...	533·9
Mean	527·3 ...	425·4 ...	485·2 ...	479·3

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	Variance.	"Z."	"Significance."
Blocks	9	15,773	—	—
Spacings	2	52,440	0·414	none.
Error (*a*)	18	22,944		
Sub-blocks	29	—	—	—
Plants hole	1	179,197	1·318	100:1
S. × P.	2	980	—	—
Error (*b*)	26	12,835		

Conclusions—The differences between the three spacings are not significant. Two plants per hole yield a significantly greater number of cobs than one plant per hole. There is no interaction between the two factors.

B. YIELD: LBS. OF HULLED GRAIN.

TREATMENT MEANS.

	3 ft. by 1 ft.	3 ft. by 2 ft.	2 ft. by 1 ft. 9 ins.	Mean
One plant per hole	129·1	123·7	120·8	124·5
Two plants per hole	100·5	119·4	114·1	111·3
Mean	114·8	121·5	117·4	117·9

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	Variance.	"Z."	"Significance."
Blocks	9	1,381	—	—
Spacing	2	231	—	none.
Error (*a*)	18	831		
Sub-blocks	29	—	—	—
Plants hole	1	2,604	1·630	100:1
S. × P.	2	899	—	none.
Error (*b*)	26	730		

Conclusions.—There are no significant differences in yield due to the differences in spacing. The yields from plots with two plants per hole are significantly lower than those from plots with single plants; as the number of cobs was significantly higher in the former plots it follows that where two plants stand in one hole the weight of the individual crops produced is very much reduced.

ANALYSIS OF YIELD.

Plants per hole—	Stand.	Cobs/plant.	Weight of Cob (grain)—lbs.
3 ft. by 1 ft.	560	0·849	0·271
3 ft. by 2 ft.	280	1·342	0·329
2 ft. by 1 ft. 9 ins.	480	0·880	0·286
Plants per hole—			
3 ft. by 1 ft.	1,120	0·517	0·174
3 ft. by 2 ft.	560	0·848	0·251
2 ft. by 1 ft. 9 ins.	960	0·571	0·208

SECTION V.—MISCELLANEOUS CROPS.

SWEET POTATOES—VARIETY TRIAL AT NGETTA.

A variety trial of seven local varieties was laid down in the form of a seven by seven Latin square, planted on 30th September. Each sub-plot was 36 ft. by 36 ft., and the plants were spaced 3 ft. each way. The varieties and the total yields obtained are as follows:

A.	Ayagogo (red)	581 lbs.	2,790 lbs. per acre.
B.	Ochan Kumatek (white)	1,675 ,,	8,033 ,,
C.	Ojonyi (white)	1,440 ,,	6,924 ,,
D.	Oleke	1,575 ,,	7,562 ,,
E.	Odurubong	930 ,,	4,470 ,,
F.	Kampala (white)	1,345 ,,	6,453 ,,
G.	Adago	1,698 ,,	8,167 ,,

Analysis of the results indicates that the least significant difference at P. ·05 between the above total yields is 175 lbs.

Conclusion.—The varieties fall into the following groups in respect to yield:

(*a*)	High (7,500—8,200 lbs. per acre)	Varieties *B*, *D* and *G*.
(*b*)	Second (6,000—7,000 lbs. per acre)	Varieties *C* and *F*.
(*c*)	Low (4,470 lbs. per acre)	Variety *E*.
(*d*)	Very poor (2,790 lbs. per acre)	Variety *A*.

CULTIVATION TRIAL WITH SWEET POTATOES AT NGETTA.

Five methods of cultivation were tried in a five by five Latin square, the plots being 84 ft. by 24 ft. The methods and yields therefrom are as follows :—

A.	Heaps spaced 2 ft. by 2 ft.	1,833 lbs.
B.	Heaps spaced 3 ft. by 3 ft.	2,157 ,,
C.	Heaps spaced 4 ft. by 4 ft.	1,862 ,,
D.	Ridged by hand, 3 ft. spacing	1,775 ,,
E.	Ridged by plough, 2·4 ft. spacing	1,861 ,,

Analysis of the results indicates that there is no significant difference between any of the methods of cultivation used in this experiment.

COVER CROPS AND GREEN MANURES.

The two best cover crops at Serere during the year were *Stizolobium deeringianum* and *Centrosema pubescens*. The former produces a mass of mulch if left down for nine months, and it seeds profusely, producing some 1,400 lbs. seed per acre from a seed rate of about 16 lbs., planted at 3 ft. by 3 ft. The *Centrosema* was established from setts amongst the Oil Palms. Its initial growth is slow but once it is well established it seems capable of surviving for a number of years and to smother all weeds with the exception of an *Euphorbia* sp., which is very common on Serere.

The three best green manures were Sword Bean (*Canavalia ensiformis*), Sunn Hemp (*Crotalaria juncea*) and *Dolichos lablab*. All three produce a rapid green cover in the Spring, suitable for ploughing in prior to the planting of cotton. Sword beans and *Dolichos lablab* also make quite good cover crops. The following were the seed rates used and the yields obtained on the seed increase plots :

	Seed Rate per acre. Lbs.	*Yield per acre.* Lbs.
Sword Beans (2 ft. by 1 ft. 6 ins. at two seeds per hole) ...	108	1,600
Dolichos lablab (2 ft. by 1 ft. 6 ins. at two seeds per hole)	22	450
Sunn Hemp	80	1,500

At Bugusege (Bugishu), plots of the following were planted during October to observe their behaviour during the dry season : *Crotalaria alata*, *C. intermedia*, *C. incana*, *Canavalia ensiformis*, and *Indigofera anil*. The only one which produced any reasonable cover was *C. incana*.

FIBRES.

Sunn Hemp (*Crotalaria juncea*).

During the year some rettings were made to check the results obtained in the previous season. In general, the weather conditions were not very favourable for this crop, the frequent dry spells checked growth, and the seed production was low.

The results obtained were as follows :—

Period.	*Weight of Green Material per acre—Lbs.*	*Weight of Fibre per acre—Lbs.*
(*a*) 46 days from sowing date	22,264	Too immature.
(*b*) 108 days from sowing date	25,168	249·9
(*c*) 140 days from sowing date	20,570	499·2
(*d*) 150 days from sowing date	17,908	424·13

These results indicate that the best period for the production of green material is 108 days from sowing date. From the viewpoint of fibre production a period of 140 days from sowing date is necessary.

In the year 1931, twenty-six samples of Sunn Hemp were prepared and later fowarded to the Imperial Institute for report. The samples represented the fibre obtained in the course of certain trials carried out at Serere, involving various seed-rates and differing conditions of retting and stripping. It was desired to ascertain (*a*) the quality and value of the samples in comparison with standard grades of Sunn Hemp, and (*b*) which of the combinations of treatment had yielded the best fibre.

The results of the examination afford no clear indication as to which combination of seed rate per acre, period of growth and retting treatment proved the most satisfactory, but the following conclusions can be used as a basis for future work.

Seed Rate.—The seed rate of 60 lbs. per acre appeared on the whole to be the most satisfactory. The products representing the 60 lbs. seed rate were generally slightly superior in colour and appearance to the other samples.

Period of Growth.—Several of the samples of 108 days' growth contained some rather short fibre but otherwise they were not inferior to the samples representing the longer periods of growth. Apart from possible differences in the yield of fibre per acre, there would seem to be no obvious advantage in the longer periods of growth.

Retting Treatment.—On the whole a five-days' retting period would appear to be the most suitable for adoption. Samples retted for a shorter period were rather gummy, and those retted for a longer period showed some deterioration, the fibre being rather weak and somewhat towy. It was observed that the fibre which had been stripped immediately after retting was softer, of better colour and more effectively separated than that which had been stripped on the third day after retting.

Commercial Values.—The samples were submitted to a firm of merchants in London for valuation. At the date of the valuations the following prices were quoted for various grades of Indian Sunn Hemp :

Fine Philibit	£14 10s.—£16 per ton.
Fine Jubblepore	£16 10s.—£18 ,, ,,
Fine Sewnee	£17—£19 ,, ,,
Fine Itarsi	£18—£20 ,, ,,
Fine Dewghuddy	£20—£23 ,, ,,

The three best samples were reported on as follows :

" *Sample No. 5.*—(Seven days' retting stripped wet) 3—3½ feet, fairly light colour with good gloss, soft fibre, fairly free and more like regular Bengal, mixed in strength, fair to very weak in parts, still contains some adhering fibre and thick soft root ends. Value £16 per ton."

" *Sample No. 17.*—(Five days' retting) 4 ft., fibre fairly free, although still some gummy and adhering pieces, nice gloss, good strength throughout. Value £16 per ton."

" *Sample No. 22.*—(3½ days' retting) 5 ft., medium brownish to lighter colour, fairly well grown as shown by the length, but proportion very poor and containing a large quantity of gummy adhering fibre throughout, no freedom whatever in the fibre, excellent strength. Possibly worth £15 per ton if the fibre was a bit freer."

Jute. (*Corchorus* sp.—*Olitorious*?).

This crop suffered severely from the repeated dry spells with the result that only a few plants attained a height of more than 5½ feet. A few plants were retted and the following results obtained :—

Period.	*Retting Period. Days.*	*Estimated Yield of Fibre per acre. lbs.*	*ozs.*
82 days from sowing date	10 ...	514	4
96 days from sowing date	9 ...	605	0
110 days from sowing date	9 ...	455	12
124 days from sowing date	9 ...	665	8

The fibre from the above treatments proved to be extremely variable in colour and texture, the earlier rettings being slightly lighter in colour and less harsh. Samples of string and rope, prepared at Serere by hand, were inferior to similar samples prepared from Sunn Hemp.

OIL SEEDS.

Shea Nuts (*Butyrospermum Parkii*).

Observations were made during the year on six wild trees in the station at Serere. The following yields were obtained during 1932 :

Tree No. 1 ... 156 seeds.	Tree No. 3 ... 157 seeds.	Tree No. 5 ... 506 seeds.
Tree No. 2 ... 87 seeds.	Tree No. 4 ... Nil.	Tree No. 6 ... 33 seeds.

It appears that this species does not produce a crop every year. Observations on these trees are being continued.

A large number of the seedlings planted in 1931 have since died from various causes. *Rhizoctonia solani* was found on some, while others were obviously damaged by termites. Growth of the remaining seedlings is very slow. Blanks are being refilled by planting at stake as this is probably the most suitable method. Owing to the long tap-root of the young seedling it is almost impossible to avoid damage when transplanting from the nursery.

OIL PALM (*ELAEIS GUINEENSIS*).

The Oil Palms at Serere planted in August, 1931, are growing satisfactorily. A few of the outstanding plants have been selected by the Assistant Botanist for growth and other records. At Wanyange 282 plants were planted in September 1931. These are growing equally well.

HYDNOCARPUS WIGHTIANA.

Three trees (two female and one male) have survived from seven germinations out of 330 seeds sown in September, 1925. The first fruit ripened in October, 1931, six years from sowing date. The yields to date are :

October, 1931, to April, 1932	16 fruits.
July, 1932, to October, 1932	26 ,,
December, 1932, to May, 1933	20 ,,

The fruits contain from twelve to twenty seeds, averaging about sixteen seeds per fruit. The trees now carry a very heavy crop which should ripen about July, 1933. A good germination is being obtained from the home-grown seed. Seedlings to the number of 65 were planted out at Serere in August, 1932, so as to increase the source of seed supply for the local leper hospitals ; forty seedlings were distributed to the Leper Hospital at Kumi in April, 1933.

TUNG OIL (*ALEURITES FORDII*).

174 seeds were received and planted in the nursery on the 30th September, 1931. Twenty-six seedlings obtained from this number were planted out on the 10th March, 1932, at 25 ft. by 25 ft spacing, on a rocky plot near the office at Serere. Twenty plants have survived to date. These show stunted growth due probably to the rocky nature of the soil. A fresh supply of seed has been received for further plantings.

OTHER EXPERIMENTS AND WORK.

Two experiments on Serere, one to determine the best rotation and the other to determine the best method of preventing erosion, have not yet completed their cycle and figures are therefore incomplete.

In regard to the rotation experiment, it is now obvious that permanent cultivation, using green manure only to maintain fertility, is not a satisfactory method for this area of the Protectorate. The rotation plots laid down in 1929-30, at numerous centres within the area, also produced, in 1932, poorer crops than neighbouring native plots. Unfortunately, the figures of yields from these plots are too unreliable for statistical analysis. It was decided, however, that there was sufficient visible proof against permanent cultivation and, in consequence, all the rotations practised on the experiment farms were altered to allow of a 3- or 4-year resting period under the most suitable local grasses. The rotation plots in the districts were abandoned and where possible planted up with grass.

Observation work on grasses is being conducted on Ngetta Farm. The inclusion of "grass" in the rotations is also likely to provide useful information on the subject of agricultural practice in this area of the Protectorate.

NURSERY—SERERE.

A new nursery was prepared at Serere towards the latter end of 1932. During the year, 1,152 plants of fruit trees and 25 packets of seed of the same were distributed to various applicants. Some 6,000 lbs. of mango seeds were also handed over to the Forest Department.

D. STEDMAN DAVIES,

Acting Senior Agricultural Officer.

ANNUAL REPORT, BUKALASA EXPERIMENT STATION, 1932-33.

During the year under report no material alterations have been made in the organisation of the work carried out on the plantation. Of the three main divisions, a report on cotton breeding work will be found in the Report of the Senior Botanist. Educational activities are described in the Report of the Superintendent, Agricultural Education. This report deals only with general experimental work.

METEOROLOGICAL.

The weather during the year was somewhat abnormal in that several abnormally wet and abnormally dry periods were experienced. During May and June, the weather was unusually dry, while during November the rainfall was considerably above average. The total rainfall for the twelve months ended December, 1932, was 58·95 inches, compared with an average fall of 51·37 inches for the preceding eleven years.

COTTON.

Sowing Dates and Spacing Experiment.—The object of this experiment and the results of previous years' work will be found in the Reports for 1930 and 1931.

Lay-out.—An eight by eight Latin square, sub-plots measuring 36 ft. by 30 ft. Two spacings, 4 ft. by 2 ft. and 3 ft. by 1 ft., in the following sowing dates: early July, mid July early August, mid August.

Results:—

	Early July.		*Mid July.*		*Early August.*		*Mid August.*		*S.E. of difference.*
	3×1	4×2	3×1	4×2	3×1	4×2	3×1	4×2	
Mean yield in lbs. of eight sub-plots	13·25	14·12	15·12	14·5	14·0	11·37	11·25	10·62	1·4
Lbs. per acre	530·0	564·8	604·8	580·0	560·0	454·8	450·0	242·8	—

The above results are significant in that there is no difference between spacings of 3 ft. by 1 ft. and 4 ft. by 2 ft., irrespective of sowing dates. There is significance in the sowing dates irrespective of spacings: early July and mid July are better than mid August, and early August is nearly significant over mid August. The interaction between sowing date and spacing is significant and the indications are that the later the sowing the closer, within reason, should be the spacing.

Sub-soiling Experiment.—The object of this experiment was outlined in the Report of 1930-31. In many areas of Buganda, the soil underlying the first nine to twelve inches of top soil is a compact and, to some extent, impervious clay. This results in abnormal root development of deep-rooting crops, and it was considered that this restriction of root development might result in reduced yields and greater susceptibility to adverse climatic condition. The effect of sub-soiling has been investigated with both cotton and maize.

Lay-out.—Twelve one-sixth-acre strips in *A*, *BB*, *AA*, *BB* . . . *A* pattern. Six of these strips were sub-soiled and six left as controls. In the cotton crop the plants were badly attacked by Lygus and Helopeltis, and Angular Leaf Spot was prevalent.

Results.—

	COTTON.		*MAIZE.*	
	Sub-soiled.	*Control.*	*Sub-soiled.*	*Control.*
Mean yield in lbs. of six sub-plots	32·8	35·8	997·7	1,016·6
Lbs. per acre	393·6	429·6	5,986·2	6,099·6

In the case of both the cotton and the maize crops the differences obtained are not significant. These results bear out those obtained in the previous season, when no differences in yield were obtained. Since the experiment began, only in the first year has sub-soiling resulted in an increased yield.

Mulching Experiment.—One of the greatest needs in present native agricultural practice is to find some practical means of preventing, in so far as is possible, soil erosion, and of maintaining soil fertility. With this object in view, in elephant grass country the possibilities of mulching with this grass are being investigated.

Lay-out.—Twenty sub-plots of ten rows each. Position of the sub-plots in the block decided at random. Planted at the end of July at a spacing of 3 ft. by 1 ft.

Results.—

MEAN YIELD OF SUB-PLOTS IN LBS.

	1st quality cotton.	*Stained cotton.*	*Total.*	*% Stained cotton.*
Control	39·13	3·77	42·9	12·6
Mulched	38·54	4·36	42·9	13·5

The average yield per acre equals 429 lbs. The results of this experiment are negative in so far as yields of seed cotton are concerned. Since the experiment started, this is the first time that mulched cotton has given no increase in yield over the control. The reason for this may be the abnormal weather conditions experienced which enabled the control plots to produce a second crop greater than that produced by mulching. An interesting feature of this experiment is the fact that cotton from the mulched plots gave a 3% higher ginning out-turn than that from the controls.

OTHER CROPS.

GROUNDNUTS.

ROSETTE DISEASE EXPERIMENT.

The object of this experiment is to ascertain the effect of various cultural treatments on the incidence of rosette disease and the effect of such treatments on ultimate yield.

Lay-out.—A five by five Latin square, sub-plots 44 ft. by 36 ft. Two spacings, 1 ft. by 1 ft. and 2 ft. by 2 ft. with the following treatments :—

A. Spacing 1 ft. by 1 ft. : Clean weeded.
B. Spacing 2 ft. by 2 ft. : Clean weeded.
C. Spacing 2 ft. by 2 ft. : Weeded six inches around plants only.
D. Spacing 2 ft. by 2 ft. : Mulched with elephant grass from germination.
E. Spacing 2 ft. by 2 ft. : Mulched two months after germination, otherwise as *C.*

The experiment was planted on 4th November, 1932, and the rosette count was taken on 24th January, 1933.

Incidence of Rosette Disease.—Mean percentage of the stand infected with rosette :—

A ... 2·70. *B* ... 6·38. *C* ... 5·24. *D* ... 9·14. *E* ... 3·5. S.E. of difference ... 1·83.

These results are significant in that treatment *A* results in less disease than treatments *B* and *D*, treatment *E* less than *D*, and treatment *C* less than *D*.

YIELDS.

	TREATMENTS.					
	A.	*B.*	*C.*	*D.*	*E.*	*S.E.*
Mean yields in lbs. of five sub-plots ...	59·8	34·4	19·4	34·2	28·2	5·3
Percentage of mean	169·5	98·0	55·1	97·0	80·2	15·1
Lbs. per acre	1,614	928	523	923	761	—

The above results are significant and the following conclusions can be drawn : *A* is better than all other treatments, *B* and *D* better than *C*, *E* probably better than *C*. Treatment *C* caused considerable loss in yield, equivalent to 43% compared with clean weeding. The spacing of 1 ft. by 1 ft. gave 71% increase in yield over 2 ft. by 2 ft. spacing.

GROUNDNUTS SPACING EXPERIMENT.

Lay-out.—A four by four Latin square.

Variety.—Bukalasa Bunch.

Spacings.—1 ft. by 6 ins., 1 ft. by 1 ft., 1 ft. by 1½ ft., 1 ft. by 2 ft.

Mean Yield of Four Sub-plots in Lbs :—

1 ft. × ½ ft. ... 384·7.
1 ft. × 1 ft. ... 345·0.
1 ft. × 1½ ft. ... 315·2.
1 ft. × 2 ft. ... 271·0.

The above differences are not significant.

During the year the following groundnut varieties were introduced and tested against the Bukalasa variety. Yields of unshelled nuts per acre were at the rate of :—

Virginia Bunch ... 3,139 lbs. Basse ... 1,820 lbs. Bukalasa Bunch ... 2,382 lbs.

Phillipine Pink ... 3,458 lbs. H.G.I. ... 1,888 lbs.

Groundnuts Ridging Experiment.

As in previous years, it was found that no increase in yield is obtained from growing groundnuts on ridges as opposed to ordinary flat cultivation.

SWEET POTATOES.

Plots have been maintained of a number of the more common varieties of sweet potatoes. In a variety trial conducted with six of these varieties the following results were obtained :—

Variety.	*Total Six sub-plots, lbs.*	*Total lbs.per acre.*	*Variety.*	*Total Six sub-plots, lbs.*	*Total lbs. per acre.*
1. Kawa ...	993 ...	9,185	4. Magabali ...	2,910 ...	26,917
2. Kiwoko ...	1,039 ...	9,610	5. Nakamogoli	2,313 ...	20,395
3. Kifefe ...	762 ...	7,048	6. Buwala ...	1,276 ...	11,803

With regard to palatability, native taste places Kiwoko best and Kawa second. In general, the higher yielding varieties possess the poorest eating qualities.

MAIZE.

Maize Spacing Experiment.

Lay-out.—A six by six Latin square. Plots 28 ft. by 36 ft. Spacings : 3 ft. by 9 ins., 3 ft. by 1 ft., 4 ft. by 1 ft., in each case with one and two plants per hole.

Yields.

	3 ft. by 1 ft.		3 ft. by 9 ins.		4 ft. by 1 ft.		S.E. of difference.
	1.	2.	1.	2.	1.	2.	
Mean yield in lbs. of six sub-plots.	149·0	134·0	138·1	124·5	119·7	125·7	14·76
Lbs. per acre	6,407	5,762	5,938	5,353	5,147	5,405	—

These results are significant in that 3 ft. by 1 ft. spacing with one plant per hole is significantly better than all other treatments.

Between the other spacings there is no significance.

DEMONSTRATION SMALL HOLDING.

This small holding has now completed its sixth year. The farm is worked by a man and his wife ; the wife cultivates the plantain garden and helps on the other plots, the tenant cultivates the rest of the holding.

Prior to 1932, the area of the farm was three acres, consisting of one acre of plantains, an economic crop rotation covering $1\frac{1}{3}$ acres and a food crop rotation covering two-thirds-of-an-acre. The object of the holding is to demonstrate to the native the possibility of permanent settlement on and development of a given piece of land.

It is hoped to show that by adopting a suitable rotation and some simple system of manuring, the present practice of shifting cultivation is unnecessary and uneconomic. The net profits (*i.e.*, exclusive of all food grown and consumed by the holder) obtained by the tenant since the commencement of the scheme are as under :—

1927-28 ... Shs. 108/16. 1929-30 ... Shs. 162/26. 1931-32 ... Shs. 134/15.

1928-29 ... Shs. 169/60. 1930-31 ... Shs. 163/77.

The past years have shown that the area under cultivation, *viz.*, three acres, was not the maximum possible area which a man and his family could maintain. At the beginning of 1932 the holding was consequently extended to a total of four-and-a-quarter acres, made up of a plantain garden of one-and-a-quarter acres and three acres under annual crops. One-quarter-acre of the plantain garden is inter-planted with robusta coffee.

Some difficulty has been experienced in getting the tenant to farm this area in a proper manner, but it is considered that with an energetic family a farm of the present size would not be beyond their capabilities.

Returns for the past year are as under :—

	Shs.	*Cts.*
Sweet potatoes, 461 lbs. @ 1 cent. ... ... =	4	61
Cassava, 1,619 lbs. @ 1 cent. ... ... =	16	19
Groundnuts, 169 lbs. @ 7 cents. ... ... =	11	83
Maize, 2,554 lbs. in cob @ 1 cent. ... ... =	25	54
Cotton, 575 lbs. A quality @ Shs. 10 ... ... =	57	50
60 lbs. B quality @ Shs. 3 ... ... =	1	80
Cowpeas, 73 lbs. @ 5 cents ... ... =	3	65
Sim-sim, 40 lbs. @ 7 cents ... ... =	2	80
Beans, 23 lbs. @ 5 cents ... ... =	1	15
Total Nett Profit	125	07

ROBUSTA COFFEE.

Shade and Cover Crop Experiment.

The objects and lay-out of this experiment have been detailed in previous reports. Total yields to date, in pounds of fresh cherry, are as under :—

	No Shade.		*Banana Shade.*		*Gliricidia Shade.*	
	Weeded.	*Cover Crop.*	*Weeded.*	*Cover Crop.*	*Weeded.*	*Cover Crop.*
Mean yield in lbs. of six sub-plots ...	797	471	481	343	491	337
Lbs. per acre	8,679	5,129	5,218	3,735	5,322	3,670

While it is yet too early to draw any conclusions from this experiment, it is of interest to note that up to the present there is no difference between banana shade and permanent shade, but that the yield from no shade plots is very significantly higher than from shaded plots. The yield from clean weeded plots is higher than from those with a cover crop. The advantage to clean weeded plots is the same whether no shade or shade, either temporary or permanent.

It must be emphasized that while it has been established that the treatment no shade, clean weeded, gives the best results in so far as yield is concerned during the early years of the trees' life, this is not necessarily the best treatment to advise growers to adopt. One of the main objects of this experiment is to find, if possible, some combination of shade and cover crop which will reduce the tendency exhibited by robusta of overbearing while young, with consequent dieback and probable loss of the tree after the first few crops.

Robusta Cultural Experiment.

During the spring rains of 1932 a further coffee experiment was planted up. This consists of a comparison of the effect of the following ground treatments :

Mulching with elephant grass, a permanent leguminous cover, selective weeding and clean weeding, all plots being without overhead shade.

The trees in this experiment have not yet come into bearing.

GENERAL.

During the year arrangements were made for the purchase of approximately 100 acres of land adjoining the plantation. This is to be used primarily for cotton seed increase work and will serve as one of the stages in the bulking up of new strains for general distribution.

Additional land has been cleared around the residential quarters on the hill and planted up with paspalum grass. Plots of twenty-five varieties of plantains have been maintained for observation purposes. A large number of varieties of green manures and cover crops have been grown for observation and seed increase.

A. B. KILLICK,

Senior Agricultural Officer.

ANNUAL REPORT OF THE BOTANICAL SECTION—1932-1933.

PART 1—INTRODUCTION.
PART 2—BOTANICAL WORK AT BUKALASA.
PART 3—BOTANICAL WORK AT SERERE.
PART 4—BOTANICAL WORK AT KAMPALA.
PART 5—BOTANIC GARDENS AT ENTEBBE.

PART 1—INTRODUCTION.

In the middle of 1932, the botanical work of the Department was re-organised and grouped to include the cotton breeding work and all the other botanical work together under one section.

The change necessitated an alteration of titles—the Cotton Botanist becoming the Senior Botanist and the Assistant Cotton Botanist the Assistant Botanist, while a second Assistant Botanist was appointed to carry on the botanical work in Kampala. In addition to this, the Assistant Botanist, Kampala, was relieved of practically all the systematic work through the kindness of Mrs. Tothill, who has undertaken this work in an honorary capacity as Curator of the Herbarium.

This grouping of the botanical work has so far worked very satisfactorily—a complete programme of breeding work on all economic crops of the country, which was impossible before, is now being undertaken ; in addition, the work of those officers who were previously working on cotton alone has increased in interest and has resulted in considerable broadening of ideas.

The work of the section is mainly connected with the two chief export crops of the Protectorate—cotton and coffee. But at the same time considerable attention is being paid to possible alternative crops to these from both non-native and native points of view and also work is being done with a view to improving other native export and food crops such as groundnuts and sim-sim. Cotton work is done at both Bukalasa and Serere—these two stations being representative of very different soil and climatic areas. The coffee investigations are centred at Kampala, close touch being kept with work being carried on at the Amani Institute. Work on other crops is distributed as follows :—

BUKALASA : Tobacco, Simsim, Ginger.
SERERE : Tobacco, Groundnuts, Bulo.
KAMPALA : Essential Oils, Tea, all other minor crops.

In addition to the above, the Assistant Botanist, Kampala, is responsible for the Botanic Gardens at Entebbe, where considerable improvements have been made in the last year.

The report of the section is divided into four parts : Bukalasa, Serere, Kampala, and the Botanic Gardens, Entebbe.

The following is a very short summary of the main work of the section during the past season.

COTTON.

Work in the Bukalasa zone indicates that S.G. 23.8—a low shedding, good spinning strain—has possibilities for replacing the ordinary local cotton which is deteriorating badly. Several promising lines resistant to Blackarm have been isolated and one promising U. 4 strain has reached the Pedigree Line stage.

At Serere, U. 4 derivatives are very promising and several have proved higher yielders than the Nyasaland Upland type. Selection has resulted in several U. 4 families with good lint up to 30 mm. long. Work on Blackarm resistance has here also met with satisfactory results.

As regards insect pests, the most serious was Helopeltis, although it did not appear at Serere. It is noteworthy that in both areas damage was mainly confined to early sown cotton and to cotton growing on poor soils. Lygus did considerable damage at Serere. Spraying experiments were conducted at both Bukalasa and Serere and results from the latter centre give indications of control of Lygus with a consequent increase in yield.

Blackarm was not a serious factor at either centre but work on resistance has proceeded. Very valuable assistance in this work has been received from the Mycologist.

The final course of the interchange of seed experiment was completed and results from both centres show that no permanent effect on yield or quality has resulted as a result of growing cotton out of the environment for one year.

The seed farm stage—Mulondo—for the Eastern Province gave a satisfactory yield of 479 lbs. per acre. A further segregated area comprising the remaining parts of Serere and Kasilo counties plus part of Assuret gombolola was demarcated in order to produce 1,250 tons of what can be called economically pure seed for the fifth, sixth and seventh stages of distribution.

The distribution scheme for Buganda is still in a somewhat nebulous state owing to the difficulties of obtaining a suitable area for a seed farm.

COFFEE.

New selections have been made mainly from the Nganda type, which appears to be more suitable for native cultivation than the present Robusta type; this is especially so in the Sese Islands. Vegetative reproduction has proceeded with success and seed will soon be available from the earlier grafted trees.

TEA.

There is a plot of tea in the Kampala Government shamba which is more than twenty years old and which has done well consistently. A wider interest is now being taken in the crop by planters and possibilities are certainly worth exploring from a local market point of view. Newly imported jats are under observation and the tea plots at Kampala have been considerably improved.

ESSENTIAL OILS.

Essential oils have not given satisfactory results. Reports on both indigenous and imported plants have been distinctly unfavourable.

GROUNDNUTS.

A start was made with selection work at Serere and experiments on rosette disease were conducted at both Bukalasa and Serere.

BOTANIC GARDENS.

Considerable improvements to the roads and general lay-out have been made and the appearance of the gardens has been greatly improved. Distribution of seeds and plants has proceeded as usual.

PART 2—BOTANICAL WORK AT BUKALASA.

METEOROLOGY.

The climate for the most part of the season under review was very irregular, several abnormal wet and abnormal dry periods being experienced. The total rainfall for the months of May, June and July was very low, being 4·65 inches below the average for these three months, June and July being particularly dry. The rains during this period are usually critical as, apart from building up a very necessary reserve, those in the latter part are required for cotton planting, which takes place from the beginning of July onwards. Any early planted cotton was badly checked and as a result became an easy prey to the ravages of Lygus and Helopeltis. During November, rainfall was unusually heavy and materially assisted in the spread of Angular Leaf Spot, and caused considerable bud shedding. December was normal with a dry spell in the latter half which checked the spread of disease and enabled bolls to ripen off quickly. January, on the other hand, was very abnormal, over four inches of rain falling during the last ten days; this rain, although causing a certain amount of damage to cotton where ripe bolls remained unpicked on the plants and also a certain amount of mechanical shedding, was, on balance, extremely beneficial as it enabled late formed bolls to obtain sufficient moisture to ripen thus causing a most abnormal picking peak in March which was fortunately hot and dry during the critical periods. This second peak resulted in high yields everywhere and plots on the plantation which would in a normal season have produced less than 200 lbs. per acre yielded at the rate of 400 lbs. per acre.

The following table summarises the meteorological records of the season.

Table I.

The second column of the table gives the differences from the mean of the last ten years.

Month.	*Rainfall— inches.*	*Sunshine— total hours.*	*Temperatures. Maximum.*	*Minimum.*
1932—April	7·05 +0·28	198 +44	84 +2	63 =
May	4·88 −0·02	159 − 5	82 +1	62 =
June	1·91 −1·78	132 −26	81 =	61 +1
July	0·92 −2·85	64 −53	——	——
August	6·37 +1·68	158 −10	80 −1	56 −4
September	4·67 −0·39	112 −36	80 −2	61 +1
October	8·88 +1·73	185 +14	83 =	61 =
November	8·79 +4·42	204 +27	82 −2	62 =
December	3·96 +0·95	189 +10	83 −1	60 −1
1933—January	4·08 +2·50	198 −65	84 −3	62 =
February	1·84 −0·90	182 + 8	84 −3	62 −1
March	6·72 −1·60	217 +70	86 +2	62 −2

BREEDING PLOT.

A. New Selections.

A total of 84 rows were planted in June, rather too early in the season for Buganda, but nevertheless germination was quite good. The plants suffered a severe check soon after germination owing to the dry weather in July and as a result Helopeltis did a fair amount of early damage. Angular Leaf Spot spread at approximately the same rate as in the previous season but the wet period in November accelerated infection and at this time the first signs of Blackarm were observed. Considerable variation in susceptibility to Blackarm was observed, all the B. 31 strains being very resistant and showing no signs of the disease whatsoever until the end of January when it appeared too late to cause any damage ; unfortunately, these B. 31 families appeared to be very susceptible to damage by Helopeltis, the rows were outstandingly stunted and at one time it appeared that no crop at all would be harvested from any of these families. Fortunately, however, they appeared able to overcome the attacks and produced quite a fair crop of probably the finest lint we have yet obtained from Upland types in this country. Several of these B. 31 families are distinctly promising on account of their resistance to Blackarm and their good lint qualities.

Families of B. 39 showed considerable resistance to Blackarm but were at the same time particularly susceptible to a wilt disease which is discussed below under the heading of diseases.

Families of B. 37, B. 45 and B. 42 yielded very well indeed despite the fact that the two latter were susceptible to Blackarm. Several B. 37 families are distinctly promising and have reached a stage of purity sufficient for their inclusion in the Pedigree Lines next season. Families of the U. 4 group appeared very promising early in the season on account of their very excellent storm-resistant habit and also on account of their very high rate of flowering ; as usual, however, with the U. 4 group in this area the amount of boll shedding and shrivelling was enormous and the final yields were no higher than the average for the plot. Most families had been selected on account of long lint but they reverted to the group mean of 1 in.—1⅛ in., except in the case of the progeny of U. 4.99.2 from S. Rhodesia, which produced lint of 30 mm. length and a good yield ; this is the only U. 4 new selection which has given suitable lint characters.

The yield from the whole plot was very high owing to the second picking peak. A total of 250,000 flowers were selfed during the season and 20,000 bolls were examined in the laboratory. The ginning out-turn and lint index was, on the whole, lower than in previous seasons and the number of motes per boll was exceedingly high in the first few pickings.

The following table gives a summary of some of the characters of the most promising new selections :—

Table II.—Summary of Promising New Selections.

Strain.	Mean sound locks per plant.	Mean total bolls per plant.	Mean seeds per boll.	Mean motes per boll.	Mean lint weight per boll. (grm.)	Lint Index.	G.O.T.	Lint length. (mm.)
B. 118.3 ...	222	66	29·2	6·4	1·56	5·3	29·0	36·1
B. 31.21.6 ...	97	34	31·0	1·6	1·41	4·6	30·2	38·4
B. 31.22.5 ...	95	32	28·8	3·4	1·46	5·1	30·2	33·7
B. 31.22.7 ...	138	40	32·6	2·4	1·66	5·1	32·3	33·6
B. 31.5.10.15 ...	154	49	29·8	3·8	1·63	5·5	30·3	—
B. 31.5.12.10 ...	108	35	30·0	3·4	1·43	4·8	31·9	32·0
B. 31.10.12.12 ...	100	40	32·2	2·2	1·53	4·8	29·7	34·6
B. 37.5.18.12 ..	182	54	34·2	0·8	1·92	5·6	26·5	35·4
B. 37.6.8.5 ...	110	38	31·8	3·4	1·51	4·8	27·2	34·1
B. 42.12.12.14 ...	101	40	34·0	1·4	1·42	4·2	32·6	33·4
B. 45.18.12.14 ...	120	35	33·4	3·0	2·09	6·3	31·4	32·5
B. 45.18.15.4 ...	174	50	35·2	3·0	2·35	6·7	31·1	31·8
U. 4.B.3.9 ...	155	49	28·6	4·2	1·59	5·6	30·2	29·4
U. 4.B.8.4 ...	90	27	31·2	3·0	1·81	5·8	34·0	30·3
U. 4.B.11.14 ...	148	49	30·4	2·2	1·44	4·7	30·4	30·3

B. Pedigree Lines.

Nineteen lines were grown, and in order to obtain sufficient seed for the next stages of increase the lines were grown in three rows of twenty-five plants each, the third row being used for seed purposes only, no observations being made on it.

Angular Leaf Spot and Blackarm spread steadily, as in the new selections, and lines of B. 42 and S.G. 27 families were particularly susceptible.

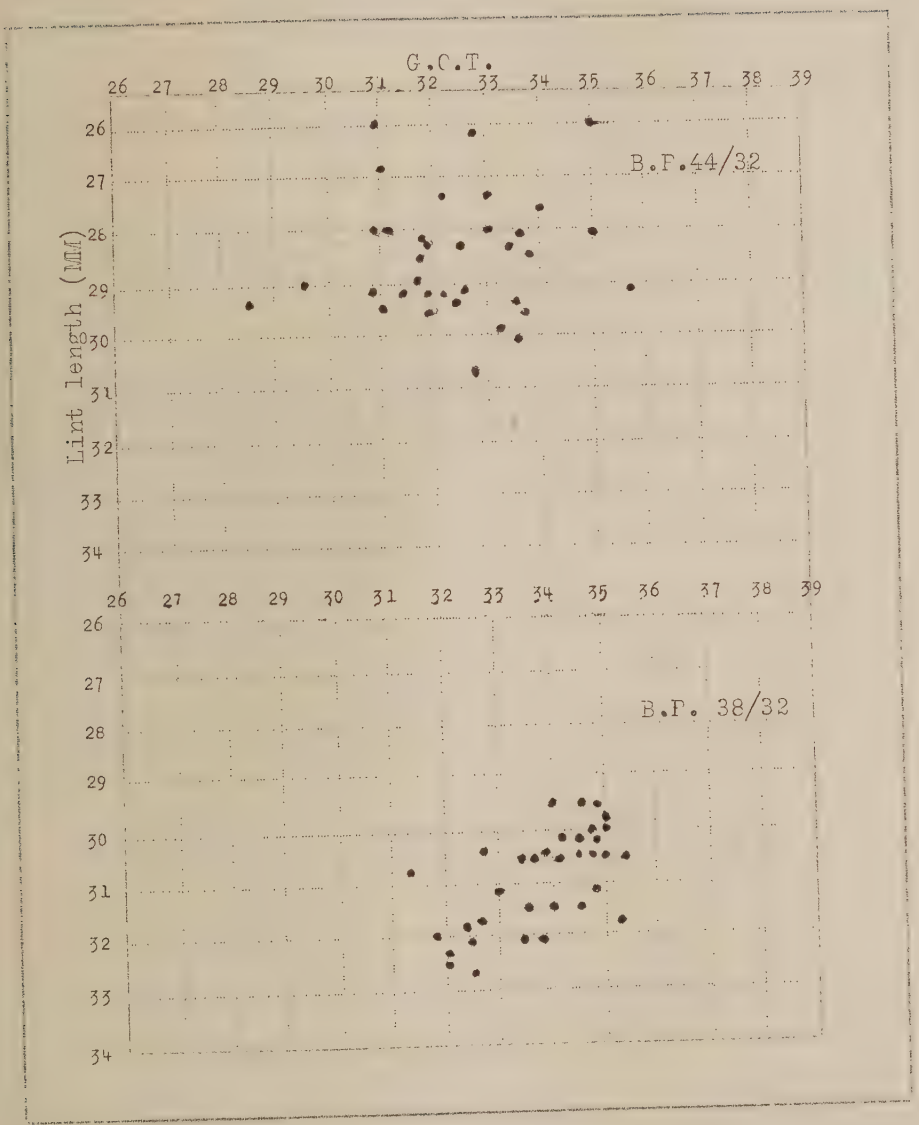
The most promising line as regards yield and quality of lint was B.P. 44.32 (actual serial number being S.G. 23.8.6.13.7.10, which means it has been selected and selfed for six generations). Unfortunately, this line is still splitting for seed characters even after this long period of selection and it has therefore been returned to the primary stage for further selection.

Eight lines of U. 4 derivatives were grown ; these flowered profusely and produced excellent storm-resistant plants. No very high yields were recorded but B.P. 38.32 gave an above normal yield combined with very satisfactory lint characters. Several lines showed resistance to Blackarm.

Lines of B. 42 origin were susceptible to Blackarm and had abominable habits but actually managed to give comparatively good yields of good quality cotton.

S.G. 27 lines were discarded on account of very bad habit of growth and high susceptibility to Blackarm.

Boll shedding was worked out for the better lines and it is interesting to note that B.P. 44.32 has retained the low boll shedding character of the original parent, S.G. 23.8, its percentage of bolls shed being 14% less than any other line.


G.C.T.
26 27 28 29 30 31 32 33 34 35 36 37 38 39
Lint length (MM)
B.P.44/32
B.P. 38/32

The following table summarises the characters of the most promising lines :—

TABLE III.

Line.	Total flowers per plant.	Total bolls per plant.	Percentage bolls shed.	Total sound locks per plant.
B.P. 28.32 (B. 42 origin) ...	61·5	19·8	67·8	50·6
S.P. 37.32 (U. 4.4.2 origin) ...	94·0	34·2	64·6	77·8
B.P. 38.32 (U. 4.4.2 origin) ...	114·0	24·4	78·6	69·5
B.P. 41.32 (U. 4.4.2 origin) ...	89·0	29·0	67·4	76·0
B.P. 44.32 (S.G. 23.8 origin) ...	60·0	29·6	50·6	97·0

TABLE IV.

Line.	Number of seeds per boll.	Motes per boll.	Lint weight per boll. (grms.).	G.O.T.	Lint index.	Lint length. (mm).
B.P. 28.32	32·4	2·4	1·69	31·8	5·2	31·6
B.P. 37.32	28·9	3·6	1·50	34·4	5·2	28·9
B.P. 38.32	28·6	3·8	1·57	33·5	5·5	30·9
B.P. 41.32	29·6	3·3	1·68	36·3	5·7	32·4
B.P. 44.32	31·6	3·0	1·74	32·2	5·5	29·0

The following target diagrams (correlation tables of G.O.T. and lint length) are interesting as they show up clearly the comparative purity of various lines. B.P. 38.32 stands out as being the most pure of all the lines. B.P. 44.32 does not show up as very pure, despite its seven generations of selfing.

INCREASE PLOTS.

The following varieties were grown for increase : S.G. 23.8, B. 16 and B.P. 21.31 (U. 4.4.2 selection). Of these three, only the first is being further increased, B. 16 being very susceptible to Blackarm and B.P. 21.31 being below standard as regards its lint characters and not showing any superiority in yield. S.G. 23.8 is well worth an intensive trial in Buganda on account of its tremendous superiority in spinning qualities over any other strain we have. S.G. 23.8 and B. 16 were grown on the same plot at widely different sowing dates, the flower buds of the early sown (S.G. 23.8) being entirely removed as soon as B. 16 approached flowering. This method was very successful and the early sown S.G. 23.8 gave over 400 lbs. per acre although it missed the second flowering peak owing to the bud removal.

The problem of the third stage of seed increase has been solved by the purchase of a further 98 acres of land at Bukalasa which will give 36 acres for cotton increase segregated by a 200-yard belt all round. The seed farm stage for Buganda has yet to be found.

A. BUKALASA. VARIETY TRIALS.

The main trial was, as usual, situated at Bukalasa and consisted of an eight by eight Latin square on a new piece of land. Planting was done on June 25th, rather too early for this area, the following varieties being included :—

Local.
S.G. 23.8.—A low shedding strain with excellent spinning qualities.
S.G. 29.—The strain being distributed in the Eastern Province.
S.G. 27.15.13.—A grandchild of S.G. 27 with more even lint and a good staple.
B.P. 6.30.—Selected S.G. 27.
B.P. 21.31.—A selection from U. 4.4.2.
N. 3.5 Bukalasa and N. 3.5 Serere grown in connection with the interchange of seed experiment.

Germination was good, the final stand being over 90%. Varietal variation in germination capacity was observed, S.G. 23.8 giving a higher germination percentage than any other variety except N. 3.5 Bukalasa while the latter was better than S.G. 29, B.P. 6.30 and B.P. 21.31 in this respect. These results were statistically significant.

Weekly counts were made of plants infected with Angular Leaf Spot and considerable varietal differences appeared, although the number of infected plants bears no relation whatsoever to the final yields, thus affording further proof that conditions on this side of the Nile do not favour the spread of Blackarm. The following table shows the mean plants infected per variety expressed as a percentage of the stand. The figures are those of the last count made.

TABLE V.

Variety.	Percentage infection Angular Leaf Spot.	Order of yield.
B.P. 21.31	5·4	4
S.G. 27.15.13	14·5	8
B.P. 6.30	16·5	7
Local	26·6	4
S.G. 29	32·3	4
S.G. 23.8	32·8	3
N. 3.5 Serere	48·0	2
N. 3.5 Bukalasa	84·1	1

The two outstanding things about this table are the high resistance of B.P. 21.31 and the great susceptibility of N. 3.5 Bukalasa. The former is undoubtedly a generic character but the latter is inexplicable ; it is possible it may in some way be connected with sowing dates, as the parent of N. 3.5 Bukalasa was planted as an increase plot about six weeks before the parents of N. 3.5 Serere. The actual loss of crop due to Blackarm was practically negligible.

Counts were also made of the incidence of damage by Lygus and Helopeltis with a view to ascertaining whether any variety showed any resistance. S.G. 29 appeared to be the most resistant variety to Helopeltis while Local was the most susceptible. No varietal differences in resistance to Lygus were observed, neither was this pest a serious factor in crop diminution this season.

With regard to general plant habit, B.P. 21.31 was outstandingly storm-resistant, the plants remaining erect and bushy throughout the season, with practically no procumbent branches. All the other varieties lodged badly and the plots of B.P. 21.31 could be easily picked out from a distance on account of their erectness.

Flower counts were made on two days per week at weekly intervals, B.P. 21.31 producing nearly twice as many flowers as the other varieties. The tremendous flower production of this variety gave place to very heavy boll shedding and shrivelling (so common with U. 4 in this country) and its resultant yield indicated that it must have shed bolls at nearly twice the rate of any other variety.

Picking was done at weekly intervals, and owing to the unusual weather in January and March, a distinct and high picking peak occurred in March. The most outstanding result was the failure of both the S.G. 27 derivatives which was expected from the flowering curves which were abnormally low.

Both N. 3.5's were better than Local but they are very mixed and consist of a mixture of Local and Nyasaland Upland. The results are tabulated below : —

TABLE VI.

Variety.	Seed cotton lbs. per plot (1/40th acre).	Seed cotton as percentage of mean.	Lint per plot.	Lint as percentage of mean.	Percentage of fifi.
N. 3.5 Bukalasa	33	123	9·4	125	15·8
N. 3.5 Serere	33	123	9·3	124	14·6
S.G. 23.8	31	116	9·3	124	12·4
S.G. 29	27	101	7·8	104	17·4
B.P. 21.31	27	101	8·9	118	17·5
Local	27	101	7·4	99	14·0
B.P. 6.30	17	64	4·4	59	21·3
S.G. 27.15.13	16	60	4·4	59	23·5
Mean	26·7	100	7·5	100	17·1
S.E. of difference	2·3	8·3	0·48	6·4	1·3

Taking the results of total seed cotton the figures are significant by the "Z" test when P is 0·01 and show the following :—

N. 3.5 Bukalasa and Serere.—Give the same yields and significantly higher yields than all the other varieties except S.G. 23.8.

S.G. 23.8, S.G. 29, B.P. 21.31 and Local.—No differences between them although there are distinct indications that S.G. 23.8 is a better yielder than the others. All these are significantly better than B. P. 6.30 and S.G. 27.15.13.

The very high yield of these plots is noteworthy, the mean yield per acre for the whole experiment being 1,068 lbs.

Taking the yields of lint per plot worked out from the actual ginning out-turn from bulked samples, significance is obtained again with following results :—

N. 3.5 Bukalasa and Serere, S.G. 23.8 and B.P. 21.31 show a significant increase in yield over the other varieties. Local and S.G. 29 give better yields than B.P. 6.30 and S.G. 27.15.13.

The high ginning out-turn of B.P. 21.31 is noteworthy and brings it well above S.G. 29 and Local. S.G. 23.8 also shows a satisfactory out-turn, bringing it on a par with N. 3.5 for lint yield.

Considerable variation in percentage of fifi (below first quality) cotton occurred and the results, worked out in the usual way, show that S.G. 23.8, as last year, gives a higher proportion of first grade cotton than other varieties, the actual results being :—

S.G. 23.8 less fifi than any variety except Local and N. 3.5 Serere. Local and N. 3.5 Serere less than any variety except S.G. 23.8 and N. 3.5 Bukalasa. N. 3.5 Bukalasa, B.P. 21.31 and S.G. 29 no difference and all three give less fifi than B.P. 6.30 and S.G. 27.15.13.

The high percentage of fifi for the two S.G. 27 derivatives is extraordinary and there is no apparent reason for this result, unless it be that the very prostrate habit of these two strains resulted in a greater amount of damage by rain than the other varieties.

TABLE VII

Variety.	Weight of 100 seeds. grms.	Lint index.	Ginning out-turn (actual).	Lint length mm.
Local	11·47	4·7	27·9	29·0
S.G. 23.8	11·06	5·1	29·8	30·2
B.P. 21.31	11·29	5·8	32·7	29·5
S.G. 29	13·40	5·8	29·3	30·9

The figures in the above table show up clearly the high G.O.T. of B.P. 21.31, while the high seed weight of S.G. 29 as compared with the other varieties is noteworthy. Local shows up very badly and the lint length is very irregular.

Taking the results as a whole it is clear that neither B.P. 6.30 or S.G. 27.15.13 are of any use in this area. Local is very mixed and the need for replacement is becoming urgent. B.P. 21.31 yields no better than Local and in addition the lint is short and very harsh and would undoubedly fetch a low price. Both the N. 3.5's are out of the picture as they are very mixed. S.G. 29 is not outstanding and had not any yield advantage. S.G. 23.8 remains the only promising variety—it has yielded as well as Local, it produces more lint than Local and in addition it has a distinctly low percentage of low grade cotton ; its low rate of shedding is a valuable characteristic and finally, it is at least 20% better than any other variety in spinning tests. The great point against it is that under Eastern Province conditions it is proved to be susceptible to Jassids. It has now been grown for three seasons in Buganda and no sign of crop reduction from Jassid has been observed ; it may, therefore, be possible that under the much more favourable soil and climatic conditions of Buganda, Jassids are not a limiting factor. It is proposed to continue testing this variety and to proceed slowly with increase.

B. OUTSIDE VARIETY TRIALS.

Variety Trials were conducted at various centres in Buganda, comparing S.G. 23.8 and S.G. 29 with Local. These centres, selected to cover as far as possible the various soils and climates in Buganda, were as follows : Nkozi, Mpigi, Kiriri, Buama, Nakifuma and Nakyesunga. The lay-out in each case was in the form of five random blocks. Only in one case was a significant result obtained, this was at Buama, where both S.G. 23.8 and Local gave increased yields over S.G. 29.

Grouping the results together and treating the collection of trials as one large variety trial with a scatter over a large area, each centre being equivalent to a single block, gives results which are significant and shows S.G. 23.8 and Local to be better yielders over the whole area than S.G. 29. The results are summarised in the table below :—

TABLE VIII.—YIELDS IN LBS. PER TOTAL OF FIVE PLOTS.

Centre.	Local.	S.G. 23.8	S.G. 29.	Total.	Yield per acre.
Nkosi	186	164	184	534	1,424
Buama	188	173	120	481	1,283
Kiriri	132	144	95	371	989
Mpigi	174	161	152	487	1,299
Nakyesunga	174	177	153	504	1,344
Nakifuma	217	185	168	570	1,520
Bukalasa	135	155	135	425	1,133
Means	172·3	166·0	144·0	482·3	1,286·1

The very high yields are noteworthy and give some indication of the yields obtainable in Buganda under conditions no better than normal. In fact, with the exception of Bukalasa, the general conditions under which these experiments were conducted can definitely be said to be below normal.

S.G. 29 does not appear likely to be suitable under Buganda conditions as its yield is lower than Local and it is not much better as regards spinning qualities. S.G. 23.8 again appears promising although in one or two centres it appears to have lost some of its length of staple.

INTERCHANGE OF SEED EXPERIMENT.

The last course of this experiment was completed this season with the expected final result that no permanent effect on yield or quality results when a variety from Serere is grown at Bukalasa or vice versa, also that any environmental effect such as disease and germination percentage is lost after the first season of return to the original environment. The only environmental effects observed throughout the whole course of the experiment were that seed from a crop grown at Bukalasa germinates much better than seed of the same variety from a crop grown at Serere. There also appeared to be an increase in primary infection of Angular Leaf Spot when the Bukalasa cotton was grown at Bukalasa after a year at Serere but, as mentioned above, this was not maintained.

TABLE IX.—1932-33 RESULTS.

Variety (origin).	Lint length mm.	Lint index	Weight 100 seeds, grms.	G. O. T (actual).	Yield, lbs. 1/40 acre.
N. 3.5 Bukalasa	33·0	5·0	12·3	28·5	33
N. 3.5 Bukalasa-Serere-Bukalasa-Bukalasa	32·0	5·0	11·8	28·1	33

SPINNING TESTS—1931-32 CROP.

These tests were, as usual, carried out by the British Cotton Industry Research Association, at Shirley, to whom we are much indebted, as well as to the Empire Cotton Growing Corporation, who arranged the tests. This season, the Indian Central Cotton Committee very kindly undertook tests on eight samples and we are very grateful for the valuable reports received on these samples.

The samples spun from the Bukalasa Zone were S.G. 23.8, Local, S.G. 29 and B. 16 ; the results are summarised in the tables below :—

TABLE X.—(B.C.I.R.A. RESULTS).

Variety.	Lea Strength at			Count Strength Product.			Brokers Valuation. Points on.
	40's.	50's.	60's.	40's.	50's.	60's.	
Local	52·9	42·3	—	2,100	2,047	—	136
S.G. 23.8	66·1	49·5	—	2,637	2,480	—	156
S.G. 29	—	38·1	26·1	—	1,978	1,670	151
B. 16	—	43·0	31·6	—	2,124	1,985	201

TABLE XI.—MEASURABLE CHARACTERS (B.C.I.R.A.).

Variety.	Mean length mm.	% short hairs.	Hair weight, cm.	% normal hairs.	% dead hai r
Local	23·0	19	0·00154mgm	42	14
S.G. 23.8	23·8	21	0·00126	43	20
S.G. 29	24·6	24	0·00155	33	19
B. 16	25·4	21	0·00154	35	17

These results give a clear indication of the superiority of S.G. 23.8—it produces a far stronger yarn than the other varieties and it has a very low hair weight per centimetre and while the number of dead hairs is higher than the other samples the percentage of normal hairs is also higher. B. 16 also produced a very satisfactory yarn and were it not susceptible to Blackarm it would be a useful second string to S.G. 23.8.

TABLE XII.—INDIAN CENTRAL COTTON COMMITTEE.

Variety.	Lea Strength at				Count Strength Product.				Graders Valuation Rs. on broach.
	20's.	30's.	40's.	50's.	20's.	30's.	40's.	50's.	
Local	99	57	37	...	1,960	1,661	1,450	...	Rs. 125/-
S.G. 23.8	...	80	53	39	...	2,411	2,109	1,952	Rs. 140/-
S.G. 29	...	71	46	33	...	2,117	1,875	1,588	Rs. 140/-

FIGURE I.

KEY TO ALL FIGURES

Local .....

S.G.23.8 - - - - - -

B.P.21/31 ———

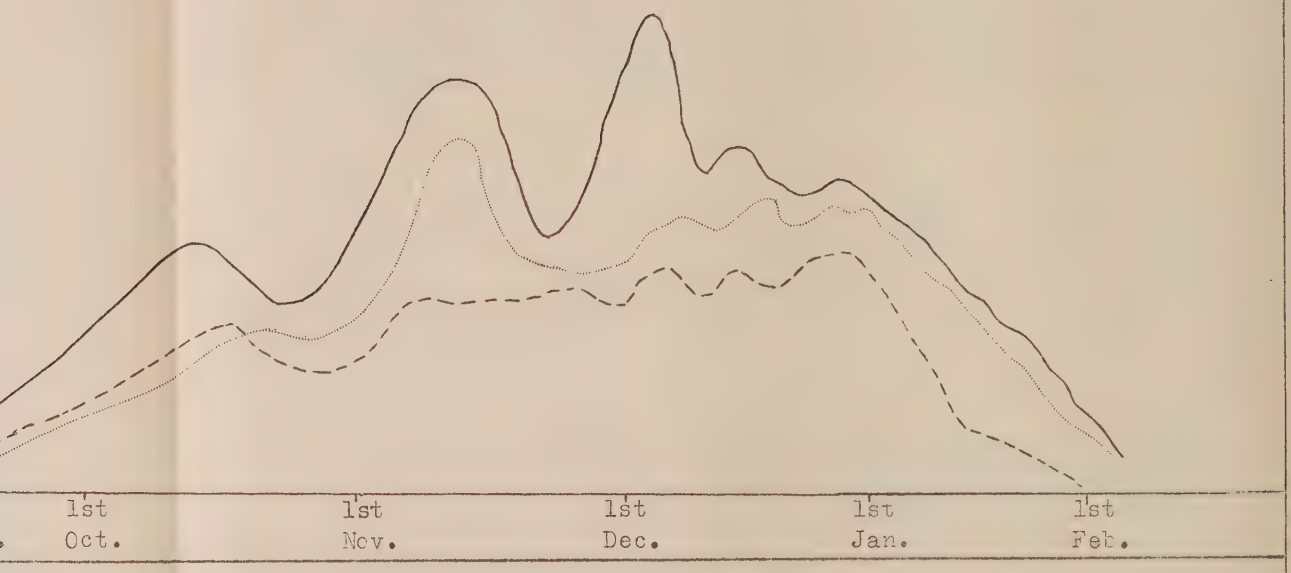


FIGURE II.

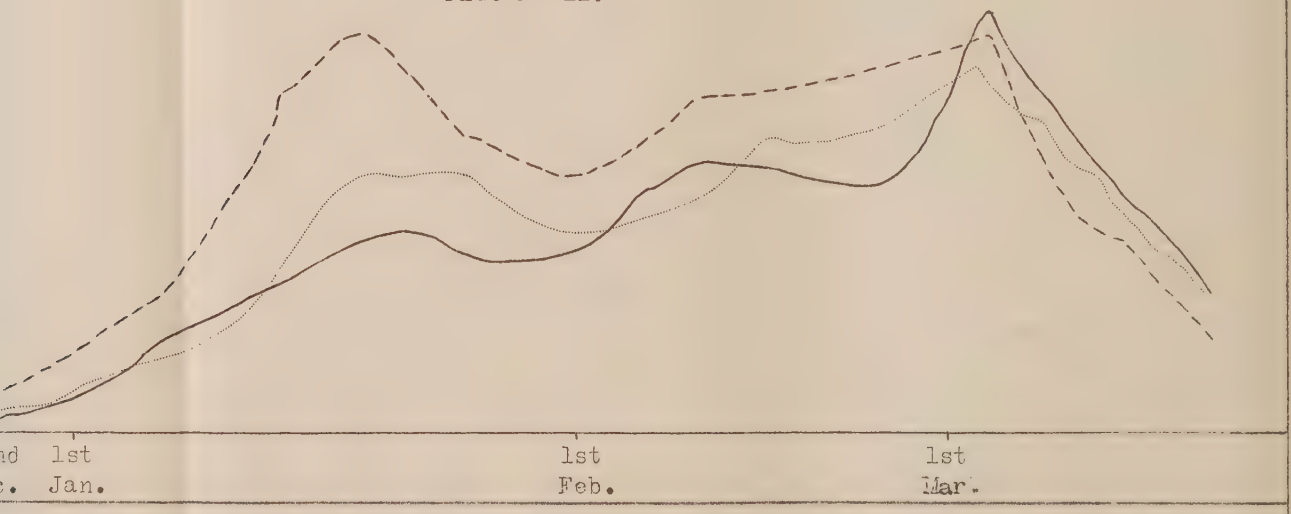


FIGURE III.

FIGURE I.

This figure represents the flowering curves of Local, S.G. 23.8 and B.P. 21.31 in the variety trial at Bukalasa, the curves being compiled from flower records made on two consecutive days per week. The very high flowering rate of B.P. 21.31 is particularly noteworthy.

FIGURE II.

This is complementary to Figure I and shows the picking curves for the same three varieties. S.G. 23.8 stands out as the highest yielder and although the scale of the two figures is not the same it is easy to see that B.P. 21.31 stands out as a high shedder, while S.G. 23.8 is the reverse. The unusual second picking peak was due to the abnormal rains of January which were followed by dry weather at suitable periods.

FIGURE III.

The percentage of cotton below first quality for each picking day for the above three varieties is shown here. B.P. 21.31 appears as a producer of a comparatively high percentage of fifi while S.G. 23.8 is noticeably a strain with less than other varieties. It is also worthy of note that the percentage of low grade cotton decreases at the picking peak periods and increases when the pickings are small. The rain in January caused a rise in the fifi peak, especially as picking at this period was from bolls low down on the plants and therefore more liable to mud splashing.

TABLE XIII.—FIBRE PARTICULARS, ETC.—(I.C.C.C.).

Variety.	Fibre length in. Bolls Sorter.	Fibre weight per inch. Millionth of an oz.	Highest standard yarn counts.
Local	1·00	0·136	37's.
S.G. 23.8	1·09	0·103	65's.
S.G. 29	1·09	0·127	45's.

Here again the superiority of S.G. 23.8 over local is clearly emphasised and is even more pronounced than in the Shirley tests.

Apart from the favourable results of S.G. 23.8 which has been placed first in every spinning test it has undergone it is a matter for some satisfaction that our new strains all show a considerable improvement over the Local cotton.

PESTS AND DISEASES.

A. INSECT PESTS.

The outstanding pest of the season was Helopeltis, which did considerable damage at Bukalasa, especially to early sown cotton. In bad cases the entire plant was stunted and the sympodia were limited to small dried-up twigs about six inches long, off which all buds shed almost as soon as they were laid down. The pest made great headway during dry weather and it certainly seems to be correlated with unhealthy conditions of the plant and thus with soil and climate. A good example of the effect of soil was seen in an increase plot of B.P. 21.31, three-quarters of which were almost completely obliterated by Helopeltis while the remaining quarter was only slightly attacked. Soil pits dug in the two areas showed that the soil in the healthy area was twice the depth of that in the area badly attacked. The strain B. 31 in the breeding plot had all its families badly attacked and it would appear that this strain is susceptible to the pest.

Other pests were not very serious and Lygus was much less so than in the previous season. Jassids were in little evidence until the end of the season. Stainers were non-existent as far as damage to the crop was concerned.

As far as this area is concerned, the following three pests appear to be the most important agents in crop reduction : Helopeltis, Lygus and Spiny Bollworm.

A spraying experiment was supervised by this section, testing spraying with a tobacco spray against control as a precaution against Lygus. This will be found in detail in the report of the Entomological section.

B. DISEASES.

The disease receiving most attention was, as usual, Blackarm, although this season it was responsible for very little damage to the crop except in the case of varieties and strains definitely susceptible to it. It appears as with Jassids, so is the case with Blackarm, that the normal conditions of soil and climate in Buganda are such as to militate against a very serious attack of the disease ; at the same time, a great deal of attention is necessary to ensure that any new variety for distribution is not susceptible in any large degree and one of the main points counting in favour of a new strain is resistance to Blackarm. Two experiments were carried out for the Mycologist in connection with work on Blackarm—a seed treatment test and a concentric ring experiment —both of which are fully discussed in the report of the Mycologist.

No other disease assumed serious proportions but a wilt disease at present unidentified appears to be on the increase in this area. The symptoms are acute wilting and, finally, shrivelling and shedding of all buds and bolls. As a rule, plants attacked are isolated ones and there appears to be no definite spread from one plant to those surrounding. One new selection, B. 39, is very susceptible to this disease and fully 70% of the plants grown of this strain were attacked by the disease. It is possible that those plants observed in native plots suffering from the disease are related to B. 39 (a locally selected plant) as no other strain under observation has suffered from it.

ROOT STUDIES.

Some preliminary work was done on the study of the cotton root, plants of three varieties with distinct habits of growth being excavated at various stages. The excavations were done by means of pits and jets of water, a very laborious process, and it is doubtful if the results obtained are worth the time expended. Differences in root development and habit appear to be governed by soil conditions and to bear no relation to the variety. One salient point confirmed by these excavations is the proximity to the surface of the main laterals, most of them being from two to three inches below the surface of the ground and therefore very liable to damage when any inter-cultivation is done, which would naturally give rise to bud and boll shedding. The effect of growing a cover crop between rows of cotton will be tested next season when comparative root excavations will be made.

COTTON SAMPLES.

Fewer samples from the districts were received than usual but those examined indicate a still further deterioration of the Buganda crop, the staple being shorter and more mixed than in previous years. An indication of the very mixed condition of this crop can seen by a casual glance at a sample of ginned seed which usually consists of a mixture of white fuzzed, green fuzzed, naked and intermediate types of seed.

G. W. NYE,
Senior Botanist.

PART 3—BOTANICAL WORK AT SERERE.

I was stationed at Serere throughout the season, and acted for the Senior Botanist until the latter returned from leave on November 18th, 1932.

I wish to express my gratitude to Mr. C. G. Hansford, Mycologist, for his very valuable assistance and co-operation, particularly in reference to his observations on the incidence of Blackarm disease in the cotton breeding plot.

METEOROLOGICAL CONDITIONS, 1932-33.

At Serere, the weather conditions were unfavourable, both for groundnuts and cotton. April was too dry for planting the former crop, and as a result the spreading varieties were not harvested until September.

With the exception of May, the cotton planting months (May to August inclusive) experienced irregular rainfall. September was abnormally wet, and hail swept over the farm on 13th September, doing considerable damage to the cotton. Angular Leaf Spot and Blackarm disease increased very rapidly during late September and early October. Fortunately, October and November were drier than usual and thus the effects of *Bacterium malvacearum* were eventually checked, although shedding increased. The chief harvesting months of December, January and February were wetter than usual. This resulted in slow picking of the crop and also some loss of crop, since cotton was washed out of the open bolls.

It is not surprising, therefore, that the yield of both cotton and groundnuts did not come up to expectation, not only at Serere, but also in Teso district.

SERERE 1932-33 SEASON. WEATHER CONDITIONS.

Month.	Rainfall.	Sunshine.	Remarks and Diseases.
1932.			
April ...	4·93 ins. below average ...	Much above average ...	Unfavourable for planting groundnuts.
May ...	3·16 ins. above average ...	Much below average ...	Ideal for planting cotton and groundnuts.
June ...	1·98 ins. below average ...	About average ...	Unfavourable for cotton planting. Rosette disease of groundnuts spread rapidly.
July ...	Exactly average, although early part of month rather dry.	Much below average. Very cloudy.	Angular Leaf Spot of cotton commenced. Unfavourable conditions for cotton planting.
August ...	0·75 ins. below average, irregular distribution.	About average ...	Angular Leaf Spot showed slight increase.
September	7·30 ins. above average. Bad hail storm on 13th September.	Very much below average.	Previous record rainfall for September, 8·92 ins. Hail caused serious damage to cotton, many apical buds broken off, plants badly defoliated and growth stopped for considerable period. Angular Leaf Spot increased very rapidly after the hail.
October ...	1·75 ins. below average ...	Much above average ...	Dry weather benefited cotton although shedding increased.
November	1·76 ins. below average ...	Much above average ...	Dry weather almost completely checked Blackarm and Angular Leaf Spot.
December	3·47 ins. above average ...	Below average ...	Wet weather had little effect on Blackarm, but resulted in some loss of cotton in the field.
1933.			
January ...	0·93 ins. above average. All at end of month.	Slightly below average	Showers at end of month delayed cotton picking, caused some loss of cotton from open bolls and lowered the grade.
February...	1·04 ins. below average. All at beginning of the month.	Average ...	Rain at beginning of the month continued to delay cotton picking. Many natives commenced planting bulo in the cotton plots.
March ...	0·23 ins. below average. Very irregular distribution.	Above average ...	Except for two large showers, month very dry; this resulted in bulo crop being severely checked.

COTTON.

Diseases and Pests.

Bacterium malvacearum.—This disease is dealt with very fully in the Mycologist's Annual Report. Further details are to be found in the section headed "Cotton Breeding Plot."

Jassids.—Except for the comparatively dry months of October and November, conditions were quite unfavourable for this pest, consequently little damage was done, although the strain S.G. 23.8 again showed itself to be very susceptible.

Helopeltis bergrothi.—Serere was almost completely free from this insect. Parts of central Bugwere, north-eastern Busoga, south Budama, and the south-eastern corner of Busoga which adjoins south Budama, were badly infested. The variety trials at Kamuge (Bugwere) and Vukula (N.E. Busoga) were very badly attacked by this insect; in fact, the Vukula trial gave about 25 lbs. per acre and was a complete failure. Wanyange Variety Trial in south-western Busoga showed infestation but the plants recovered remarkably well and the trial averaged over 900 lbs. per acre.

From observations made in the infected areas it appeared that early sown cotton and cotton planted on old plots (*i.e.*, where the land is impoverished and the plants weakly to start with) is attacked in its early stages. When the plant is attacked during its growing period and before bolls can be set, then a complete loss of crop usually results. The insect seems to confine its feeding to the green bolls when the plants are well developed. Such bolls are covered with raised brown corky scabs, but it is only when there is a large number of such scabs at the apex of the boll that loss of crop results. Under such conditions the boll begins to open prematurely and the wet and sticky undeveloped lint rots very rapidly.

Lygus vosseleri.—Practically every cotton plant at Serere showed marked damage to the leaves during the period of most rapid growth. A small spraying experiment bears out the expressions of opinion made on previous occasions by the writer that the loss of leaf area must result in a considerable loss of crop. No signs of resistance, either complete or incomplete, can be found in any of the existing strains.

The remaining pests and diseases, *e.g.*, *Earias* spp., *Dysdercus* spp. and *Areolate* mildew, were normal.

The Cotton Breeding Plot.

The following strains were planted on 5th July :—

New Selection Series.—Forty-seven rows of single plant selections, numbered S. 1 to S. 47, chiefly from Nyasaland Upland, Cambodia and Acala sources. Thirty-two rows of single plant selections numbered S.U. 1—S.U. 32 from U. 4.

Pedigree Line Series.—Nineteen Pedigree lines numbered S.P. 20 to S.P. 38 inclusive.

New Introductions.—Eleven new introductions from India, Nyasaland and Southern Rhodesia numbered X. 1 to X. 11 inclusive. The first germination was poor, averaging only 72% stand. After re-sowing a final stand of 85% was obtained.

The hail storm of 13th September did considerable damage to all plants in the breeding plot. Immediately after the hail the percentage of Angular Leaf Spot infection increased enormously. The growth of the plants was stopped and the habit ruined because most of the apical buds were killed. This severe check was reflected in the picking curves, the peak pick being nearly three weeks later than in a normal season. It was found that selection for type of plant was impracticable since the majority of the plants depended upon the formation of large monopodia after the apical buds of the main stem had been killed by hail. Preliminary observations were made on the incidence of Angular Leaf Spot and Blackarm disease.

At the end of November the Mycologist personally examined every plant in the breeding plot, giving each plant marks for leaf infection and stem infection. Leaf infection he marked from 0—6, *nil* being given to a plant showing no Angular Leaf Spot. Stem lesions, etc., he marked A, B, C, D and E; "A" being given to plants showing one small lesion, and "E" to plants showing a considerable number of lesions.

As a result of his observations it was possible to eliminate many of the New Selection series. After the results of the boll analysis were complete, about thirty-six single plants were selected from the "S." series and only eight from the "S.U." series to be returned to the New Selection series in the coming season. All these plants gave relatively high yields and were very free from both forms of Blackarm disease.

The Pedigree Line Series.—Gave some interesting results. On the score of susceptibility to Blackarm the following lines were unconditionally abandoned :—

S.P. 28 ... originally selected from U. 4, bulk.

S.P. 29, S.P. 30 ... re-selections from S.G. 29.

S.P. 31, S.P. 32 ... re-selections from S.G. 27.

The appended table summarises the chief characters of the more promising strains in this series :—

Analysis of the Characters of the Best of the 1932-33 Pedigree Lines.

Strain.	Effective flowers/plant.	Total bolls/plant.	Sound bolls/plant.	Apparent shedding percentage.	Percentage of plants showing Blackarm lesions.	Intensity of Angular Leaf Spot (based on marks 0—6).	Mean lint length mm.	Ginning Out-turn per cent.	Origin.
S.P. 20 ...	32·6	15·58	6·21	52·3	30·3	1·9	30·9	37·3	From S.P. 13 of the previous season, *i.e.*, originated from Parnell's U. 4.4.2.
S.P. 21 ...	38·8	11·17	4·52	71·2	9·1	1·7	30·8	36·2	
SP. 22 ...	36·7	11·47	5·19	68·7	16·3	2·1	30·6	36·0	
S.P. 23 ...	33·1	9·26	4·31	72·0	28·6	2·5	31·6	36·4	From S.P. 14 of the previous season, *i.e.*, originated from Parnell's U. 4.4.2.
S.P. 24 ...	21·1	6·64	2·98	68·6	33·4	3·1	31·0	36·0	
S.P. 25 ...	35·1	12·00	4·43	65·8	52·3	3·0	31·2	35·9	
S.P. 26 ...	38·7	11·31	4·77	70·2	29·2	2·7	32·0	35·1	
S.P. 27 ...	33·8	8·74	4·36	74·1	47·6	2·3	32·1	35·9	
S.P. 33 ...	46·9	14·79	4·68	68·5	53·2	3·0	31·0	31·4	This group originated from the Nariama plant selected for Blackarm resistance in 1929.
S.P. 34 ...	41·8	10·16	3·67	75·7	26·7	2·2	31·5	32·8	
S.P. 35 ...	26·9	4·81	2·35	82·1	45·8	3·0	31·2	30·9	
S.P. 36 ...	40·7	11·70	4·95	71·2	31·8	2·0	31·6	31·9	
S.P. 38 ...	27·1	5·18	2·47	80·9	30·6	1·6	32·1	35·5	From Acala. Very good germinating powers. Late maturing.

From this table it will be seen that the most successful strains are S.P. 20 and S.P. 21, on account of their high ginning out-turn, high potential yield and high resistance to Blackarm disease. Unfortunately, their lint is rather short and is still slightly harsh. S.P. 26 and S.P. 27 have the longest staple of any of the U. 4.4.2 derivatives. S.P. 23 is probably the best of the second group taking all characters into consideration. S.P. 35, in the third group, appears to be quite unlike the related strains, S.P. 33, S.P. 34 and S.P. 36. The latter three show a very high flowering rate. S.P. 34 is the most promising on account of its Blackarm resistance, lint length and ginning out-turn.

S.P. 20, S.P. 21, S.P. 23 and S.P. 35 will be included in the 1933-34 variety trial. S.P. 35 is the worst of its group and is rather more susceptible to Jassids but is the only one of which there is sufficient seed for inclusion in the variety trial. Its behaviour will give an index as to the yield to be expected from the others of this group.

The New Introductions.

X. 1 (1027 A.L.F. Surat) and X. 5 (Nandyal 14) gave nil germination.

X. 2 (Cambodia Coimbatore No. 1), X. 3 (Cambodia Coimbatore No. 2), X. 4 (Punjab American 289 F) and X. 6 (Over the Top from Nyasaland) were abandoned owing to very high susceptibility to Blackarm disease.

The remaining introduction from Southern Rhodesia gave fairly promising results.

X. 8 (U. 4.78.3) showed particularly few stem lesions, although Angular Leaf Spot was bad.

X. 9 (U. 4.99.2.1—4) and X. 10 (U. 4.123 A) were also fairly resistant as far as lesions were concerned, the former showing the lightest Angular Leaf Spot infection of any of the new introductions.

All the Southern Rhodesian introductions will be tried another season before any selections are made.

X. 8 and X. 11 (U. 4.130 A and B) gave the highest yields.

Owing to the severe hail damage the flowering and bolling curves were found to be non-comparable with those of previous seasons and are not included for this reason.

Cotton Variety Trial—Serere.

This was situated on Block C of the experiment farm. Eight varieties (S.P. 1, U. 4, N. 17, S.G. 29, S.P. 27, S.G. 27.15.13 and S.P. 18) were scattered in eight randomised blocks.

Standard size sub-plots and standard spacing used throughout (*i.e.*, plots 27 ft. by 27 ft., spacing 3 ft. by 1 ft.).

The experiment was sown on 12th July and the poor average stand of only 64·3% was obtained ; this was due to two causes—low viability of the seed from the previous season, and twenty days of dry weather during July. Three re-sowings were made in all.

The analysis of variance of the number of blank holes per plot ten days after the first sowing showed that N. 17 gave a better original stand than all other varieties. S.P. 1, U. 4, S.P. 4 and S.G. 27.15.13 showed no difference; but they were superior to S.G. 29, S.G. 27 and S.P. 18. S.P. 18 was significantly worse than all other varieties.

Varieties.	Mean No. of blank holes per plot (Possible stand 280).	
N. 17	55	
S.G. 27.15.13	74	
U 4.	79	Differences of 12 holes per plot are significant.
SP. 1	82	
SP. 4	83	
S.G. 29	109	
S.G. 27	139	
SP. 18	185	

S.P. 18, S.G. 27 and S.G. 27.15.13 are all closely related. S.P. 1 was derived from Parnell's U. 4.4.2. S.P. 4 was derived from S.G. 35, and was selected because of its high resistance to Jassid attack.

The following figures summarise the final yield returns and characteristics of the eight varieties.

Variety.	*Mean yield per plot. lbs.*	*Mean yield as percentage of N. 17 yield.*	*Mean yield as yield per acre lbs.*	*Ginning out-turn. %*
S.P. 1	10·29	139·5	534	35·3
U. 4	9·98	135·3	518	34·5
S.G. 29	8·01	107·2	415	31·2
S.G. 27	7·73	104·7	401	30·8
S.G. 27.15.13	7·60	103·1	394	30·9
N. 17	7·38	100·0	383	31·4
SP. 18	6·74	91·4	350	30·9
SP. 4	5·60	75·9	290	29·9
Means	7·91	—	410·3	—

From the analysis of variance of plot yields a very significant value of "Z" was obtained (P. less than 0·01).

The standard error of the comparison between two variety means was 0·498 lbs.; consequently, differences of 1·02 lbs. per plot are significant (*i.e.*, differences of 12·9% of the general mean of 7·91 lbs. per plot are significant).

Conclusions.—

(1) S.P. 1. and U. 4. significantly higher yielders than all other varieties.

(2) No real difference between S.G. 29, S.G. 27, S.G. 27.15.13 and N. 17.

(3) No difference between N. 17 and S.P. 18.

(4) S.P. 4 significantly lower yielder than all other varieties. Consideration of the ginning out-turn percentages show that S.P. 1 and U. 4 form one group, the related strains S.G. 27, S.G. 27.15.13 and S.P. 18 form another group, and the related strains N. 17 and S.G. 29 form a third group. S.P. 4 gives the lowest ginning percentage of all varieties.

Consideration of the Results of the Serere Variety Trials for the Seasons 1929-30, 1930-31, 1931-32 and 1932-33.

(1) The four varieties U. 4, N. 17, S.G. 29 and S.G. 27 have occurred in the Serere Variety Trial for four successive seasons. If these trials are treated as eight randomised blocks repeated over three seasons the following results are obtained:

Analysis of Variance for Four Seasons.

	Degrees of freedom.	*Sum of Squares.*	*Variance.*	*½ loge Variance.*
Total	127	1,897·55	—	—
Seasons	3	938·35	—	—
Blocks	7 7 7 7 } 28	53·64 37·00 5·46 63·08 } 159·18	—	—
Varieties	3	292·31	97·44	2·289615
Interaction of Varieties × Seasons ...	9	365·96	40·66	1·85262
Random Errors	84	141·75	1·6875	0·26182

From the "Z" test we conclude that the effect of the varieties is highly significant, and also that the interaction of varieties × seasons is highly significant.

Variety.	*Mean yield per plot over four seasons. (lbs.)*	
U. 4.	12·12	Differences of 0·66 lbs./plot are significant.
S.G. 29	8·91	
S.G. 27	8·70	
N. 17	8·36	

Conclusions.—(1) U. 4 has given a significantly higher yield than the varieties S.G. 29, S.G. 27 and N. 17 for four seasons at Serere.

(2) There is no real difference between the varieties S.G. 29, S.G. 27 and N. 17 for these four seasons.

The nature of the interaction of Varieties × Seasons is not very obvious. The following table shows, however, that N. 17 gave a higher yield than both S.G. 29 and S.G. 27 in the first season and lower yields than either of these varieties in the second, third and fourth seasons, except in the third season, where it exceeded the yield of S.G. 27.

	Mean yield per plot expressed as a percentage of the respective seasonal means.			
Season.	U. 4.	S.G. 29.	S.G. 27.	N. 17.
1929-30 ...	160·3	79·2	76·0	84·5
1930-31 ...	105·7	103·2	104·8	86·3
1931-32 ...	110·0	100·2	93·8	96·0
1932-33 ...	120·6	96·9	93·4	89·1

Also, U. 4 in its first season gave its highest relative yield, although it appears to be regaining this ascendency when one considers the trend of its yield over the last three seasons.

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(3) The five varieties U 4, N. 17, S.G. 29, S.G. 27 and S.G. 27.15.13 have occurred in the Serere Variety Trial for the last three seasons. If these trials are treated as before, the following analysis of variance is obtained for three seasons' results :—

	Degrees of freedom.	*Sum of Squares.*	*Variance.*	*½ loge Variance.*
Total	119	1,090·50	—	—
Seasons	2	785·35	—	—
Blocks	7 7 7 } 21	104·51		
Varieties	4	44·21	11·05	1·20112
Interaction of Varieties × Seasons ...	8	24·61	3·076	0·56182
Random Errors	84	131·82	1·569	0·72525

As before, the "Z" test shows the effect of varieties to be highly significant and also a significant interaction between varieties and seasons.

Variety.	Mean yield per plot over three seasons. (lbs.).	
U 4.	9·57	Differences of 0·74 lbs./plot are significant.
S.G. 29	8·63	
S.G. 27	8·48	
S.G. 27. 15. 13	8·40	
N. 17.	7·68	

Conclusions.—

(1) U. 4 significantly better than the other varieties for three seasons at Serere.

(2) No real difference between S.G. 29, S.G. 27, and S.G. 27.15.13.

(3) Both S.G. 29 and S.G. 27 are significantly better than N. 17. If we refer back to the second conclusion from the analysis of four seasons' yields we are compelled to consider that N. 17 has deteriorated since the 1929-30 season when compared with S.G. 29 and S.G. 27.

Outside Cotton Variety Trials.

As in the previous season, four by four Latin squares were laid down at different centres scattered over the Eastern Province and Lango district. The same four varieties (S.P. 1, S.P. 4, S.G. 29 and N. 17) were included in each trial. A separate draw was made for each centre. Ten

centres in all were planted, but the results from two—*e.g.* Vukula and Aduku—were of no value.

The following table summarises the results :—

District	*Centre.*	*Means Yield Per Plot (Lbs.).* S.P. 1.	S.G. 29.	N. 17.	S.P. 4
Lango	Ngetta	16·5	13·7	14·5	13·9
	Kaberamaido	13·9	12·0	11·0	10·5
Teso	Nyero	6·9	5·3	4·9	3·3
Bugwere	Kachumbala	6·1	6·0	4·3	3·2
	Kamuge	7·7	4·7	5·5	3·0
Budama	Mulanda	19·5	15·3	16·0	16·7
Busoga	Bugaya	6·4	4·5	4·0	3·5
	Wanyange	17·0	18·6	16·6	10·7
Means (lbs. per plot)		11·7	10·0	9·6	8·1
Mean yields as percentage of N.17 yield		122	104	100	84
Mean yields as lbs. per acre		607	519	498	420

From a combined analysis of variance of the eight replications of the four by four Latin squares, differences of 1 lb. between any two varietal means were found to be highly significant. The interaction between centres and varieties was not significant.

Conclusions.—

(1) S.P. 1 significantly higher yielder than the other varieties.

(2) S.P. 4 significantly lowest yielder.

(3) No difference between S.G. 29 and N. 17.

Last season seven similar trials showed that S.G. 29 was significantly better than N. 17.

Summary of Conclusions in Respect to S.G. 29 *v.* N. 17 for the Last Four Seasons.

(1) At Serere, over the last four seasons, no real difference has been shown between S.G. 29 and N. 17.

(2) Over the last three seasons at Serere S.G. 29 has shown itself to be better than N. 17.

(3) Last season the outside variety trials at seven centres showed S.G. 29 to be better than N. 17.

(4) This season eight outside variety trials show no difference between S.G. 29 and N. 17.

(5) From (1) and (2) we concluded that N. 17 at Serere has deteriorated relative to S.G. 29 since the 1929-30 season.

(6) From (3) and (4) it appears that S.G. 29 may be commencing deterioration relative to N. 17.

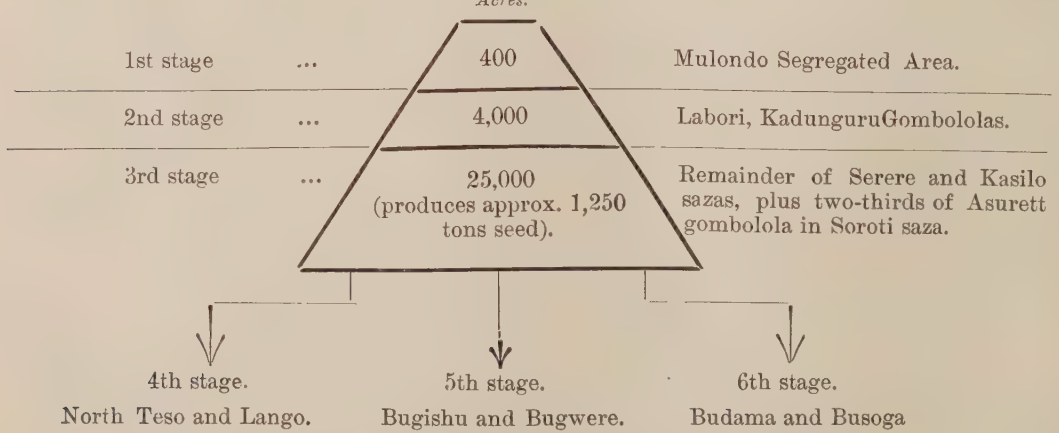
Cotton Increase Plots—Serere.

The following table summarises the results obtained from all increase plots at Serere.

Strain.	*Acreage.*	*Total yield lbs.*	*Yield per acre. lbs.*
Tororo local type	0·25	99·5	398
S.P. 4	0·25	87·4	348
S.P. 13	0·25	134·5	538
S.P. 18	0·17	32·5	191
S.G. 29	2·0	989·5	495
S.G. 29	28·67	7,722·0	269

Cotton Seed Multiplication Scheme.

A scheme known as the "District System" for seed multiplication throughout the districts east of the Nile came into operation in time for the 1932-33 cotton season. The stages in the multiplication are as follows :—


Acres.
1st stage ... 400 Mulondo Segregated Area.
2nd stage ... 4,000 Labori, KadunguruGombololas.
3rd stage ... 25,000 (produces approx. 1,250 tons seed). Remainder of Serere and Kasilo sazas, plus two-thirds of Asurett gombolola in Soroti saza.
4th stage. North Teso and Lango.
5th stage. Bugishu and Bugwere.
6th stage. Budama and Busoga

Stages 4—6 require approximately 1,250 tons of seed. By this method the whole of the Eastern Province and Lango can be covered in six years after the new strain leaves Serere. The first three stages necessitated the principle of segregation. The Mulondo area was already segregated. The two areas of Labori—Kadunguru, and the rest of Serere—Kasilo sazas were accordingly declared segregated areas.

For the season under review S.G. 29 was planted in the first three stages. It is proposed to distribute the new seed to Bugwere and Bugishu districts for the coming season (fifth stage).

The total acreage planted in Mulondo with S.G. 29 seed grown at Serere in the previous season was approximately 417½ acres. As the result of constant propaganda planting was earlier than in any previous season.

	May.	*June.*	*July*	*Aug.*	*Sept.*	*Total.*
1932-33 ...	75·67 ...	145·43 ...	136·55 ...	49·37 ...	10·26 ...	417·28
1931-32 ...	29·85 ...	70·87 ...	217·03 ...	77·95 ...	4·43 ...	400·13

From the above table of monthly plantings it can be seen that the natives planted more than twice as much for May and June than in the previous season. To prove the value of early plantings, ten plots in each month's planting were chosen at random and carefully measured. The cotton produced from these forty observation plots was noted during the buying season with the following results—

	Average yield per acre of ten native plots planted in each of the following months.			
	May.	*June.*	*July.*	*August.*
Yield per acre (lbs).	922 ...	653 ...	599 ...	437
Yield/acre as percentage of the May plots	100 ...	71 ...	65 ...	47

These figures bear out the results of several years' Sowing Date Trials conducted at Serere.

The following table shows the acreage planted, average yield per acre, etc., for the three segregated areas in the 1932-33 season :—

Segregated Area of :—	*Acres.*	*Total buyings of all grades, lbs.*	*Percentage of fifi.*	*Yield. per acre*
Mulondo	417·28 ...	199,841 ...	9·4% ...	478·9
Labori—Kadunguru	4,098·77 ...	1,509,119 ...	7·6% ...	368·2
Remainder of Serere and Kasilo sazas plus two-thirds of Asuret gombolola of Soroti saza ...	25,477·76 ...	7,078,553 ...	8·7% ...	277·8
Totals and means for all three areas	29,993·81 ...	8,787,513 ...	8·5% ...	293·0

The remainder of Teso district gave an apparent yield of 188·5 lbs. per acre and only 2·5% of fifi was purchased. This latter figure is extremely low when compared with similar figures for the segregated areas.

Lygus Spraying Experiment.

Two plots of cotton were sprayed twice weekly during the growing period. The spray consisted of a nicotine-soap mixture and was only applied to the apical buds. The appearance of the sprayed plots was remarkable. There was no leaf perforation and the plants remained very green throughout the season. The yields of the two sprayed plots were taken and also the yields of two adjacent control plots. Although no statistical significance can be attached to the yields they are of interest :

Sprayed ...	13·69 lbs.	Control ...	9·90 lbs.
Control ...	6·83 lbs.	Sprayed ...	12·75 lbs.
Mean yield of two sprayed plots			13·22 lbs.
Mean yield of two control plots			8·37 lbs.

It is hoped that this experiment will be repeated next season, using enough replications to obtain significance. The work was carried out by a native agricultural assistant loaned by the Entomologist.

COTTON CROP ESTIMATION.

Results Obtained in the Districts East of the Nile.

An estimate of the cotton crop is required annually during the first week of December every year, and in consequence the following method was employed for the first time in the 1932-33 season.

Each Agricultural Officer made two diagonal traverses across his district, from N.E. to S.W. and from N.W. to S.E. (The reason being that in general yields tend to increase from North to South and if two traverses were made from North to South and East to West the latter might give a very biassed set of samples). On these traverses the officer stopped at five-mile intervals and made the following observations on the nearest road side cotton plot :—

(1) The approximate sowing date of the plot.

(2) The distance in inches between eleven successive plants in one row of cotton chosen at random (*i.e.*, measures ten gaps).

(3) The distance apart, in inches, of eleven successive rows of cotton (*i.e.*, measures ten gaps).

(4) The number of bolls of any stage of development on each of ten plants measured in (2).

(5) Ten bolls picked at random, cut open, and the number of loculi counted, also the number of diseased locs. determined.

(6) A further random sample of ten sound open bolls—noting the total number of loculi. These samples of seed cotton were then sent to Serere and were weighed in gms. From this weight the average weight of a single loculus was obtained.

(7) The severity of the major diseases and pests was noted for each sample, and marks given according to the following scale :—

Nil.		*Little.*		*Mederate.*		*Severe.*
0	...	3	...	6	...	9

All the observations were written on special forms and the forms sent to Serere for computation. The yield per acre for each district was obtained from the following formula :—

$$\text{Yield per acre in lbs.} = \frac{6{,}272{,}640}{454} \left\{ \frac{be\left(c - \frac{cd}{100}\right)}{a} \right\} \qquad (1)$$

where 6,272,640 = number of square inches in one acre.

454 = number of gms. in one pound.

a = average area per plant in square inches—obtained from observations (2) and (3) above.

b = average number of bolls (of any stage of development) per plant. Obtained from observation (4).

c = average number of locs. per boll obtained from observation (5).

d = the percentage of diseased locs. per boll. Obtained from observation (5).

e = the average weight of a single good loc. in gms. Obtained from observation (6).

The following figures were obtained for those districts east of the Nile which were sampled :—

District.	*No. of samples made.*	*Mean area per plant sq. ins.* a.	*Mean bolls per plant.* b.	*Mean loc. No.* c.	*Percentage of diseased locs.* d.	*Mean weight of a loc.* e.	*Yield per acre lbs. from formula (1) above.*
Chua and Gulu ...	18	1,770	13·59	4·083	25·9	1·176	377·6
Lango	37	1,589	12·53	3·959	23·8	1·293	424·9
Teso	30	1,416	9·69	4·010	16·6	1·116	353·0
Bugwere	15	1,827	9·81	4·107	8·0	1·163	326·2
Budama	10	2,185	14·73	4·110	7·2	1·266	450·0
Busoga	29	1,472	13·58	4·121	20·0	1·370	575·7

The above yields per acre, obtained from formula (1), are based on the assumption of a linear relationship between yield per acre and the number of plants per acre.

During the season under review, the writer conducted a triplicate spacing trial of cotton using the four spacings 3 ft. by 6 ins., 3 ft. by 1 ft., 3 ft. by 1½ ft. and 3 ft. by 3 ft. From this it was found possible to calculate a quadratic regression for yield and spacing (area per plant). The quadratic regression formula so obtained was as follows :—

$$Y = 73{\cdot}42 + 0{\cdot}5728\,A - {\cdot}003086\,A^2 \qquad (2)$$

Where Y = percentage yield taking maximum yield as 100%

$$A = \frac{\text{Sq. ins. per plant}}{10} = \frac{a}{10}$$

the limits of application of this curve are 200 to 1,700 sq. ins. per plant. Above 1,700 it was assumed that yield is proportional to the stand since the individual plants attain their maximum development without interference or competition. In other words, the yield is inversely proportional to the area per plant and the formula

$$Y = K \times \frac{1}{a} \qquad (3)$$

Where $K = 13{,}800$.

$$A = \frac{a}{10}$$

can be used between the limits of 1,700 sq. ins. per plant and infinity.

Using formulæ (2) and (3) we obtain conversion factors to correct the yields per acre of the different districts obtained from formula (1) and we now have a new set of yield figures :—

District.	*Area per plant.* a.	*Conversion factors % for* a.	*Yield from Formula (1).*	*Converted yield using the regression formulae.*
Chua and Gulu	1,770	77·97 (3)	377·6	294·4
Lango	1,589	86·52 (2)	424·9	367·6
Teso	1,416	92·65 (2)	353·0	327·1
Bugwere	1,827	75·53 (3)	326·2	246·4
Budama	2,185	63·16 (3)	450·0	315·6
Busoga	1,472	90·87 (2)	575·7	523·1

The numbers in brackets following the conversion factors refer to the formula used.

The following table shows the actual apparent yields of the districts, obtained from the buying returns and acreage figures (neither of which are absolutely accurate), compared with the two sets of yield figures obtained from the samples.

District.	*Actual apparent yield from buying returns.*	*Yield by Formula (1).*	*Deviation of formula (1) from actual %.*	*Yield using regression conversions.*	*Deviation corrected yield from actual %*
Chua and Gulu	284·9	377·6	+ 32·6	294·4	+ 3·33
Lango	334·6	424·9	+ 21·2	367·6	+ 9·86
Teso	211·4	353·0	+ 67·0	327·1	+ 54·73
Bugwere	239·6	326·2	+ 36·2	246·4	+ 2·84
Budama	312·4	449·7	+ 43·6	315·6	+ 1·02
Busoga	393·8	575·7	+ 46·2	523·1	+ 32·83
Mean deviation % from actual yield ...	...	—	+ 41·13	—	+ 17·44

It will be seen that in every case the use of the regression conversion factors has increased the accuracy of the estimate very considerably. In fact, the converted estimates for Chua and Gulu, Lango, Bugwere and Budama are very close to the actual apparent yield. Busoga and Teso, however, are very badly out. In the former district, it is conceivable that crop was lost due to rain in the picking season. Further, the regression of yield on stand may be very different in the elephant grass country of Busoga. The case of Teso is more difficult to explain. The sampling was done at the end of November. There was an appreciable amount of rain during the picking season, which no doubt caused some loss. But it is probable that north and east Teso suffered more severely from Blackarm than was at first thought. North Teso definitely had bad Blackarm, and many plants died in December when the picking should have been at its peak. However, the method employed has given good results considering the difficulties of sampling.

An interesting point brought out by the quadratic regression curve is that the optimum spacing (obtained by differentiating the expression to zero) is approximately 3 ft. by 2 ft. (actually 3 ft. by 26 inches, or 928 sq. ins. per plant) when using S.G. 29.

The values of "a" for the different districts are also of considerable interest. They forcibly bring home to one how poor the stands are in native shambas in certain districts, especially Budama.

(2) GROUNDNUTS.

Breeding Plot.

As the result of the re-organisation of the Botanical section, the writer undertook the task of attempting to improve the yield per acre of groundnuts.

A breeding plot was sown on 10th May, 1932. Forty-six single plant lines were included, also fourteen groups of new introductions. A spacing of 3 ft. by 1 ft. was used for both bunch and spreading types. A plan of the weekly incidence of rosette disease was kept and at harvest every plant was weighed individually. About five hundred single plant re-selections were made. Eventually, these were cut down to 76 spreading and 78 bunch re-selections, which will be planted as single plant rows in 1933. All these re-selected plants gave at least 20 gms. of nuts each, and showed no signs of rosette disease throughout the season. It is doubtful whether it is possible to obtain resistance to rosette disease by simple selection but it is intended to select only those plants which show no infection for several years.

Under the conditions of native cultivation, rosette disease is not a major problem because the native broadcasts his plots with a liberal seed rate and consequently obtains very close spacing. Furthermore, he does not weed his plots unduly. These two factors—close spacing and a good ground cover—definitely inhibit the disease.

Rosette Experiment.—The following experiment was carried out to obtain further information on the subject of rosette disease—two small plots were marked out at a spacing of 3 ft. by 1 ft. One plot, the larger, contained 2,646 holes and was planted with bunch type groundnuts. The smaller plot was planted with spreading (runner) type and contained 1,519 holes.

The wide spacing of 3 ft. by 1 ft. was purposely adopted so that a heavy incidence of rosette disease was assured.

Both plots were sown on 26th May, satisfactory germination took place from 1st June to 5th June.

The bunch type were lifted on 13th September, and the spreading on 7th October. The season was not a normal one, since June was exceptionally dry and checked the plants in their early stages, whilst September was extremely wet. Usually, the bunch type are in the ground for three months and the spreading for four. In this instance, both took a month

longer than usual to reach maturity. At harvest each plant was picked into a separate envelope. After drying out, the produce of each individual plant was shelled and the weight of good nuts determined. Weighings were done on an Avery balance to 1/100th of a gramme.

Weekly rosette counts were made by native assistants. A plan of each plot was prepared and the date of the incidence of infection on individual plants was noted on these plans.

The first rosette count was made on 6th June. Subsequent counts were made at weekly intervals up to 2nd August. This gave a total of nine counts.

Tables 1 and 2 show the results obtained from the observations made on the two types. It will be seen that the proportion of plants giving " nil " yield decreases the later the incidence of the disease. This is true for both types. Also, it will be noted, that the spreading type shows a markedly higher proportion of plants giving " nil " yield than does the bunch. The variation of plant yield is higher in the spreading, either this type is more genetically mixed than the bunch, or it is more susceptible to changes in environment.

Table 3 summarises the comparisons to be made between the two types. The bunch type is superior to the spreading in every case except that of final percentage of plants showing rosette symptoms, the spreading having 10% less than the bunch.

TABLE 1.—BUNCH TYPE.

Count.	A		B		Total yield. Gms. of good nuts.	Mean yield per plant. Gms. of good nuts.	Mean yield per plant as a percentage of mean yield of all unattacked plants.
	No. of plants newly infected.	As a percentage of the total plants in the plot.	No. of plants giving nil yield from those infected at this count.	As a percentage of those infected at the same count.			
1 ...	7	0·30	6	85·7	4·54	0·65	5·7
2 ...	30	1·27	29	96·7	8·72	0·29	2·5
3 ...	45	1·91	41	91·1	13·52	0·30	2·6
4 ...	77	3·27	65	84·4	52·78	0·69	6·0
5 ...	118	5·01	103	87·3	116·48	0·99	8·6
6 ...	168	7·14	117	69·6	176·77	1·05	9·1
7 ...	122	5·18	74	60·7	399·80	3·28	28·5
8 ...	304	12·91	47	15·5	1,535·34	5·05	43·9
9 ...	223	9·47	28	12·6	1,662·72	7·46	64·9
Totals and Means of Infected Plants.	1,094	Percentage infection. 46·46	510	Percentage giving nil yield. 46·6	3,970·63	Mean yield infected plants 3·63	...
Totals and Means of Uninfected Plants.	1,260	Percentage not infected. 53·52	100	Percentage giving nil yield. 7·9	14,488·76	Mean yield uninfected plants. 11·50	...
Totals and Means of all Plants.	2,354	...	610	Percentage giving nil yield. 25·9	18,459·39	Mean yield all plants. 78·4	...

TABLE 2.—SPREADING TYPE.

Count.	A		B		Total yield. Gms of good nuts.	Mean yield per plant. Gms. of good nuts.	Mean yield per plant as a percentage of mean yield of all unattacked plants.
	No. of plants newly infected.	As a percentage of the total plants in the plot.	No. of plants giving nil yield from those infected at this count.	As a percentage of those infected at the same count			
1 ...	22	1·60	19	86·4	19·14	0·87	7·9
2 ...	28	2·03	19	67·9	92·02	3·29	30·0
3 ...	39	2·83	28	71·8	116·24	2·98	27·1
4 ...	59	4·28	47	79·7	122·80	2·08	18·9
5 ...	16	1·16	13	81·3	49·30	3·08	28·1
6 ...	90	6·54	78	86·7	147·62	1·64	14·9
7 ...	176	12·78	142	80·7	288·13	1·64	14·9
8 ...	50	3·63	38	76·0	219·90	4·40	40·1
9 ...	20	1·45	13	65·0	60·00	3·00	27·3
Totals and Means of Infected Plants.	500	Percentage infection. 36·31	397	Percentage giving nil yield. 79·4	1,115·15	Mean yield infected plants. 2·23	...
Totals and Means of Uninfected Plants.	877	Percentage not infected. 63·69	313	Percentage giving nil yield. 35·7	9,626·82	Mean yield uninfected plants. 10·98	...
Totals and Means of all Plants.	1,377	...	710	Percentage giving nil yield. 51·6	10,741·97	Mean yield all plants. 7·80	...

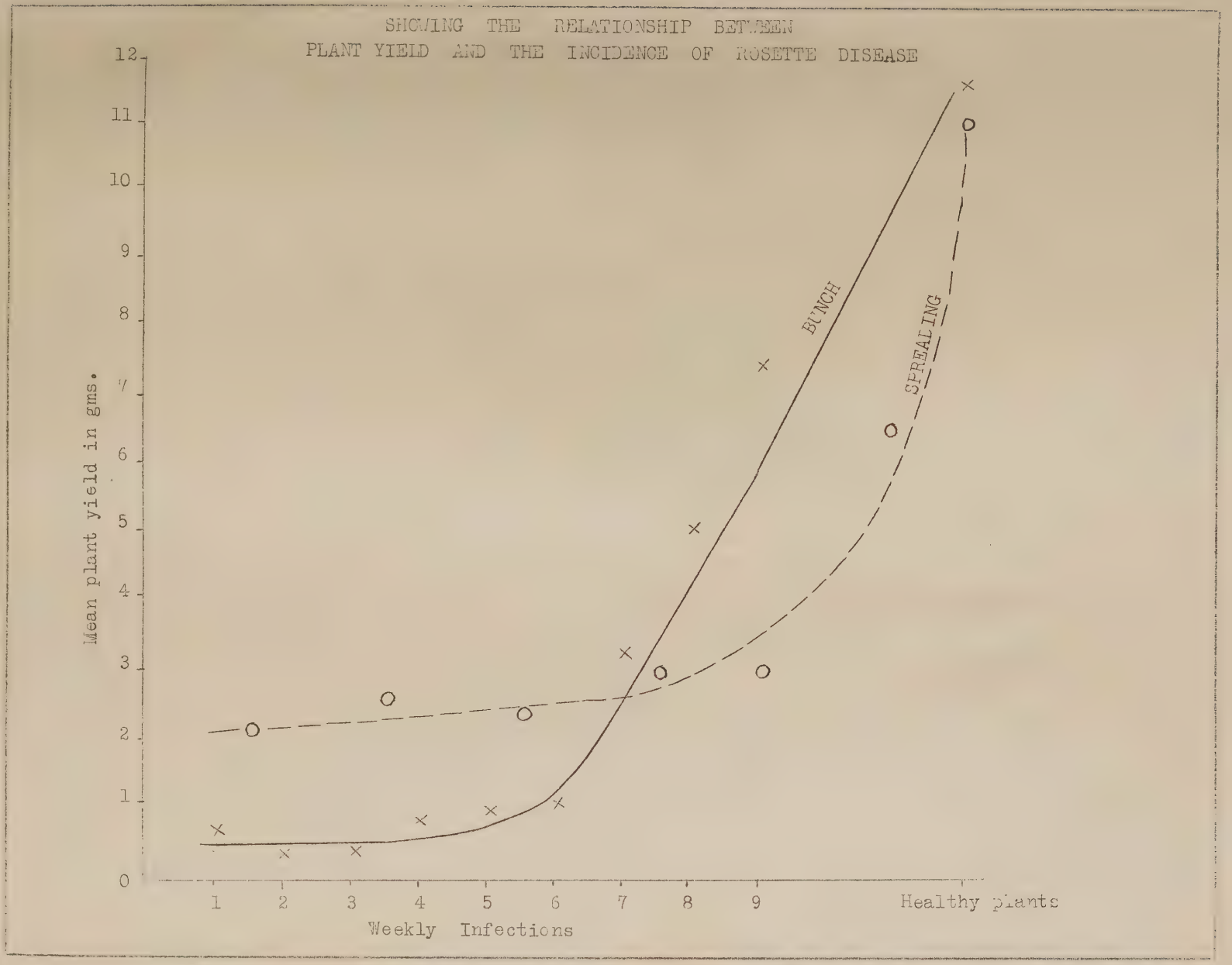

SHOWING THE RELATIONSHIP BETWEEN
PLANT YIELD AND THE INCIDENCE OF ROSETTE DISEASE
Mean plant yield in gms.
0
1
2
3
4
5
6
7
8
9
10
11
12
BUNCH
SPREADING
1
2
3
4
5
6
7
8
9
Healthy plants
Weekly Infections

Figure (i)

RATE OF INFECTION

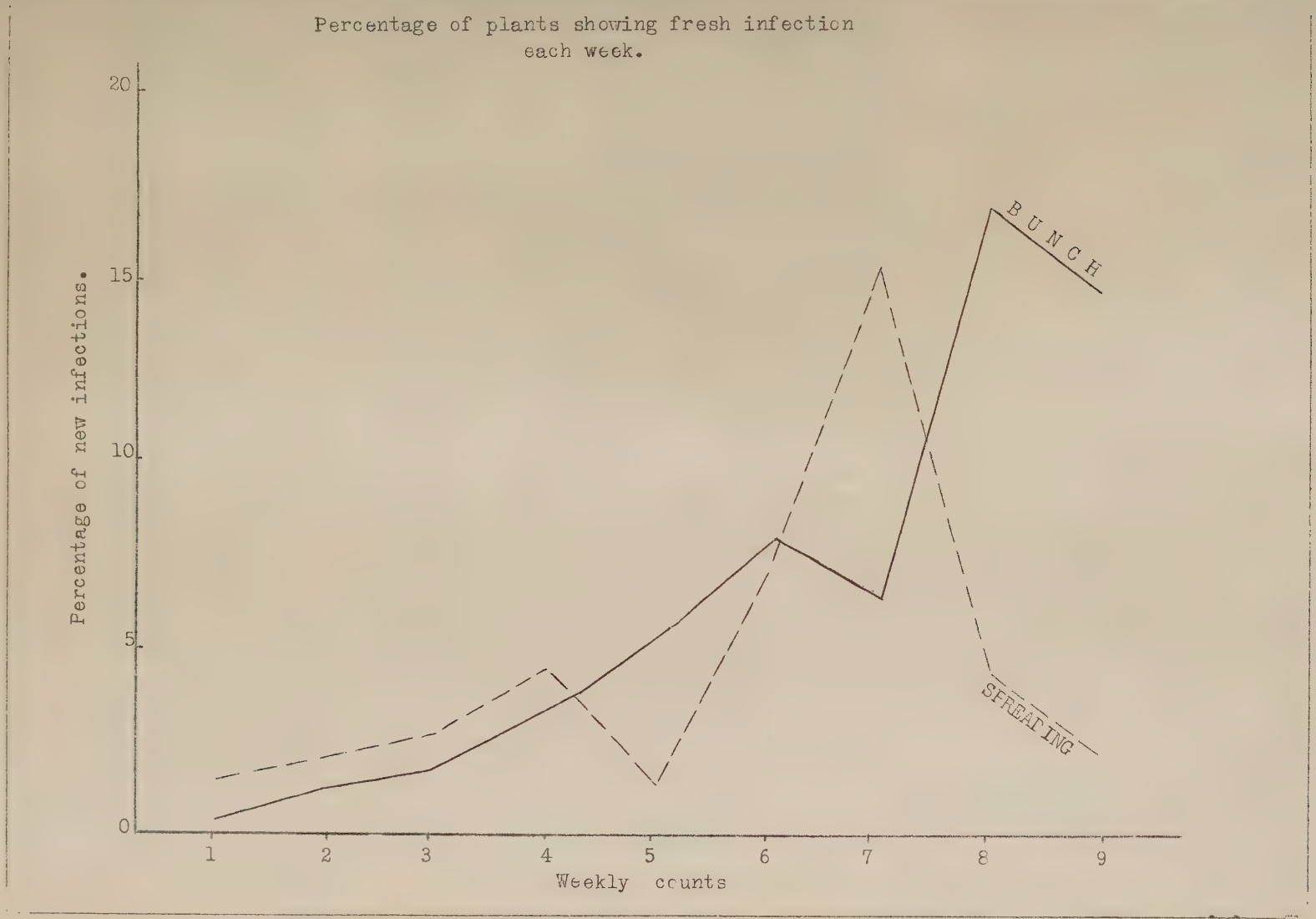


Figure (ii)

Table 3.—Comparisons Between Bunch and Spreading Types.

	Bunch.	*Spreading.*
Percentage of plants showing rosette	46·46%	36·31%
Mean yield per plant (gms. of good nuts)	7·84 gms.	7·80 gms.
Mean yield per uninfected plant	11·50 gms.	10·98 gms.
Mean yield per infected plant	3·63 gms.	2·23 gms.
Percentage of all plants giving nil yield	25·9%	51·6%
Percentage of infected plants giving nil yield	46·6%	79·4%
Percentage of uninfected plants giving nil yield	7·9%	35·7%
Depressing Effect of Rosette on yield as a percentage of mean yield of uninfected plants	67%	80%

Table 4.—Comparative Rate of Infection from Week to Week of the Two Types.

Count.	*Rate of infection—plants per 100—during each successive week.* *Bunch.*	*Spreading.*	*Ratio of rate of infection of Bunch to Spreading.*
1	0·30	1·60	1:5·3
2	1·28	2·07	1:1·6
3	1·94	2·94	1:1·5
4	3·39	4·58	1:1·4
5	5·38	1·30	1:0·4
6	8·09	7·42	1:0·9
7	6·39	15·67	1:2·4
8	17·01	5·28	1:0·3
9	15·04	2·23	1:0·1
Average infection rate for nine weeks—plants per 100 ...	6·54	4·79	

Based on the number of new infections each week expressed as a percentage of the total plants left uninfected at the commencement of that week.

Rosette caused a loss of 80% of the plant's yield in the case of the spreading type as compared with 67% in the bunch. Figure 1 shows the relationship between date of incidence of rosette and plant yield. It will be seen that there is a clear relationship between these two factors in the bunch type, while in the spreading this relationship is not so clearly marked. Figure 2 and Table 4, show the rate of infection (plants per 100) from week to week for both types. Both curves show two distinct peaks. The bunch peaks occur at the sixth and eighth counts whilst the spreading peaks are at the fourth and seventh counts. It will be seen that the spreading type shows a higher rate of infection than the bunch for the first four counts. At the fifth, sixth, eighth and ninth counts, the position is reversed. The reason for the conflicting seventh count is not clear. It was noted that at the spacing used (3 ft. by 1 ft.) the spreading type made an almost complete cover, whilst the bunch type came nowhere near it. We know that a good cover inhibits the spread of the disease, so this will explain why the rate of spread decreased so rapidly for the spreading type at the eighth and ninth counts, while the bunch continued to show an increase in this respect.

When we consider the comparative rate of spread of the two types during the first four counts—that is, when neither approached a good cover—we are forced to the conclusion that the spreading type is more inherently susceptible to the disease during its early stages than is the bunch type. As a corollary to this we could expect a greater yield from the bunch type provided it could be planted close enough to give a rapid cover to the soil.

Conclusions:—

(1) Until the spreading type produces a good ground cover, rosette disease spreads more rapidly in this type than in the bunch.

(2) After the spreading type has produced a ground cover the disease spreads more rapidly in the bunch type.

(3) Spreading is inherently more susceptible to the disease than bunch in the early stages of growth.

(4) A clear relationship was found to exist between the date of incidence of the disease and plant yield. As is to be expected, the earlier the disease infects the plant, the lower the plant yield.

(5) Given optimum spacing for both types, one would expect the best yield per acre from bunch type.

H. RIVERS HOSKING,
Assistant Botanist.

PART 4—BOTANICAL WORK AT KAMPALA.

STAFF.

Mr. E. A. Ruck was in charge of the botanical work at Kampala and of the Botanic Gardens at Entebbe until I arrived in February; after that month, Mr. Ruck continued the work of propagation of various crops at Kampala and of the supervision of the Botanic Gardens. In addition, when Mr. Stuckey went on leave in June, Mr. Ruck took over charge of the Kampala Plantation. When Mr. Ruck proceeded on leave in November, I took over the charge of the Kampala Plantation and of the Botanic Gardens, Entebbe, until the end of the year.

COFFEE.

2. Several safaris were undertaken to visit various coffee growing districts in Uganda in order to gain a knowledge of the different conditions which obtain in these areas. These safaris included visits to Bunyoro (in May), to the Sese Islands (in June), to Mityana (in July), to Bugishu (in August), to Toro and Bwamba (in September); Kyagwe and the Mabira Forest areas were also visited.

3. Observations were continued on the coffee selections made by Mr. Snowden, and further notes were made. It is considered that the chief desiderata for Robusta coffee in Uganda are strong healthy growth, and heavy bearing character. In order to assess vigour and yielding capacity it is essential that observations should be continued for some years, and it is considered that it would be premature to submit samples of all the individual trees for liquoring quality until it is certain that these trees possess the more important characters. It is also of importance that only mature trees should be selected, for longevity is highly desirable; in some cases it was found that young trees, labelled in 1931, have already deteriorated.

4. Only a small number of new selections—eleven in all—were made, and these were mostly of trees of the spreading " Nganda " type; this type usually bears fruits smaller than those of the more erect type, but in vigour and in habit it possesses many advantages, especially for cultivation by natives. On the Sese Islands, the erect type has proved to be quite unsuited to the local conditions; therefore, five of the best of the trees of the Nganda type, which has been cultivated there for a long time, were selected to provide a source of seed for the gombolola nurseries; about 30,000 seedlings from these five trees will be available for distribution during the present year.

5. Vegetative propagation of selected trees was continued, using the technique of cleft grafting which was worked out in 1931. In April, there were planted out 105 grafted trees, of which the scions had been obtained from twenty selections—six *Coffea arabica* and fourteen *Coffea robusta*. These have been arranged in blocks, each of nine trees of one clone, planted at a close spacing (4 ft. by 4 ft.), in order that each block may be surrounded by netting when they are in flower, and that self pollinated seed may be obtained.

6. A packet of seed of *Coffea stenophylla*, received from the Gold Coast at the end of 1931, germinated very well and the seedlings were potted up; this species is of considerable interest, although its commercial value has not yet been proved.

TEA.

7. In December, 1931, there was received from India seed of the Dangri Manipuri, Dhonjan Assam, Betjan Assam and Rajghur jats of tea. The germination of the seed would appear to be very satisfactory, when the distance of transportation is taken into account:—

Jat (or Variety).	*No. of Seeds Sown.*	*No. of Seeds Germinated.*	*Percentage of Germination.*
Dhonjan Assam	600	383	64
Dangri Manipuri	657	353	54
Rajghur	775	470	61
Betjan Assam	627	351	56

Unfortunately, before the end of the year, many of the seedlings died; specimens were forwarded to the Mycologist, who found a growth of *Fusarium* sp. on the roots, and who regarded the presence of this fungus as a symptom of unfavourable soil conditions. The Dangri and Dhonjan seedlings have not been so badly affected as have those of the other jats.

8. On plot No. 30 in the Kampala Plantation there was planted in 1911 a patch of Assam Indigenous tea. The bushes were plucked until 1931, when two-thirds of the plot was allowed to grow tall, to form trees for a source of seed. In October and November, these seed-bearers were rigorously thinned, about 60% of the poorer trees being removed, and the remainder were pruned, in order to improve the shape of the trees. The plot was weeded and mulched with elephant grass, to stimulate growth, for in part of the plot the trees were stunted.

HEVEA RUBBER.

9. It would not appear likely that the planting of rubber will again be an economic proposition in Uganda, in view of the low prices ruling at present, and of the large areas in the East which are now untapped, but which would be developed should conditions improve. Therefore no further work on this crop has been prosecuted; if planting material should be required at a future date, it will be available from the recorded trees at Kampala and Entebbe.

CINCHONA.

10. A number of the selected trees of *Cinchona Josephiana* in the plot at Kitubulu have been successfully propagated by side grafting; but, as with *Hevea* rubber, it would seem unlikely that this crop will be of much commerical value in the future; for the synthetic anti-malarial preparations show promise of displacing quinine.

ESSENTIAL OIL PLANTS.

11. The work of propagation of the stocks of essential oil plants was continued throughout the year, and further material was handed over to the Agricultural Chemist.

12. In the Annual Report of the Agricultural Chemist there are summarised the reports received from the Imperial Institute on the oils obtained from the following exotics:—

Pelargonium radula—" Rose Geranium."
Pogostemon patchouly—" Patchouly."
Cymbopogon citratus—" Lemon Grass."
Cinnamomum zeylanicum—" Cinnamon."

13. In no instance would the reports appear to justify a recommendation that the plant should be cultivated on a large scale in Uganda. Nor does it appear that an oil of commercial value can be obtained from the indigenous plants, of which particulars are also included in the same report:—

Ocimum sp.—" Mujaja omunene."
Coleus sp.—" Kawamala."
Coleus sp.— (Fleshy leaved).
Ocimum menthaefolium—" Kakubansiri."
Hoslundia opposita— " Kamunye."

14. There are being successfully grown on the Kampala Plantation the following plants, of which stocks are not yet adequate for the distillation of samples of oil large enough for report:—

Pelargonium sp. var.—Attar of Roses.
Pelargonium capitatum.
Pelargonium pinnatum.
Pelargonium odoratissimum.
Mentha viridis.
Mentha aquatica.
Mentha piperita.
Lippia citriodora.

15. There have also been tried the following plants, whose growth has not been satisfactory, and which, on that account, appear to be of little commercial value under conditions similar to those at Kampala:—

Lavendula vera—"Lavender."
Lavendula spica—" Spike Lavender."
Rosmarinus officinalis—" Rosemary."
Thymus vulgaris.—" Thyme."
Pelargonium fragrans.
Reseda odorata—" Mignonette."

16. During October, November and December, in conjunction with the Assistant Chemist, an extended trial of infleurage of the flowers of *Plumeria acutifolia* (Frangipani) was carried out, using sim-sim oil as the absorptive body; at the end of the experiment, after 33 charges of flowers had been exposed, it was found that the oil had absorbed little of the scent of the flowers.

17. A sample of 15 lbs. roots of *Vetiveria zizanoides* (Vetiver grass), forwarded to the Imperial Institute in 1931, received an unfavourable report, for they contained only 1·2 per cent. of essential oil, while roots from other parts of the Empire have furnished yields up to 3·3 per cent. Another sample of 15 lbs. was prepared in 1932 and has been forwarded for report.

FIXED OILS.

18. *Elaeis Guineensis* (Oil Palm).—The records of yields of individual palms at Entebbe have been continued, and there has been sown seed of some of the high yielding trees. (Nos. 6, 10, 12, 22, 35, 41, 53, 68, 77, 78, 192, 194, 198, 230). Of the seed imported from Nigeria in 1931, there have germinated the following:—

Tree No.		*No. of Seedlings.*
222	Ordinary thick shelled	0
340	Ordinary thin shelled	4
341	Green fruited thick shelled	10
384	Green fruited thin shelled	10

19. *Aleurites* spp. (Tung Oil).—The trees planted at Kampala in 1930 have not made very good growth during 1931; it may be that the local climatic factors are not suitable—from results in other countries it would appear that *Aleurites Fordii* requires a definite cold season to produce an annual resting period.

20. *Hydnocarpus Anthelmintica.*—The plots of *Hydnocarpus anthelmintica* planted in 1929 at Kampala and Entebbe have made strong erect growth, attaining an average height of 12—14 feet, but have not yet flowered.

21. *Hydnocarpus Wightiana.*—The plot of *Hydnocarpus Wightiana* at Entebbe has not grown so rapidly as has that on the Kampala Plantation; at Entebbe few fruits have ripened, while at Kampala some trees have already produced good yields, of which the particulars are given in the Annual Report on the Government Plantation, Kampala. In July, there was forwarded to the British Empire Leprosy Relief Association a sample of two pounds of seed: the report on this seed stated that:—

" The results of examination show that the Uganda seeds give a satisfactory yield " of oil, but that the oil is not quite normal in character, the saponification value being " below the lowest limit given for that constant in the pharmacopeia. Similarly, the " saponification value for the esters is below the official minimum. On the other hand,

" the iodine value and the specific rotation of both the oil and the esters prepared from " it are equal to, or above, the pharmacopeial maxima for these constants, and as these " are at present regarded as the most important criteria of the quality of *Hydnocarpus* " *Wightiana* oil, the oil from these Uganda kernels should be quite suitable for use either " alone or for the preparation of derivatives for the treatment of Leprosy. It should, " however, be pointed out that owing to the slight abnormalities referred to above, oil " of the quality of this sample would not be regarded as conforming strictly to the " requirements of the Pharmacopeia. In view of these abnormalities it would be " interesting to know whether these seeds came from young trees or whether there was " anything unusual about the ripening of the fruits. If so, it would be of interest to " examine samples of seeds from future harvests in order to see whether these " abnormalities persist."

22. *Carapa grandiflora.*—The seedlings of this tree were potted up, and some have been sent to Bukalasa to be planted there, while the remainder will be planted at Entebbe during 1933.

SPICES AND CONDIMENTS.

23. *Cinnamomum zeylanicum* (Cinnamon).—In addition to the distillation of cinnamon bark, an attempt was made to prepare cinnamon quills from bark of trees in the Botanic Gardens; the attempt was not very successful, for the bark was thin and brittle and the internodes were short. However, a small sample was forwarded to the Imperial Institute for report.

24. *Coriandrum sativum* (Coriander).—Two strains of Coriander were grown on the Kampala plantation, one with round fruits, which was obtained from France, and one with oval fruits, purchased locally in the bazaar. Small plots of both types were sown in April; the bazaar strain ripened in July, yielding at the rate of 185 lbs. per acre, while the French strain ripened in August, and yielded at the rate of 182 lbs. per acre.

25. *Pipper nigrum* (Black Pepper).—A packet of seed, received from the Gold Coast in February, germinated very well; three boxes of seedlings were pricked out and subsequently about 100 plants were potted up.

FIBRES.

26. On the Kampala plantation there were continued trials of:—

Crotolaria juncea (Sunn Hemp).
Hibiscus sabdariffa var. *altissima* (Rozelle).
Boehmeria nivea (Ramie).
Corchoris capsularis (Jute).

27. There were forwarded to the Imperial Institute samples of fibre extracted from the stalks of a species of *Musa*, introduced and cultivated on the Kampala Plantation as *Musa textilis* (Manilla Hemp). The report received was as follows:—

" The present samples of fibre are of excellent pale colour, fairly good lustre and " satisfactory length, but so deficient in strength as to be quite unsuitable for cordage " purposes. Such fibre could not be saleable in the United Kingdom except, perhaps, " at a very low price."

Examination in the Herbarium at Kew of pressed material has shown that the plants are not *Musa textilis*, but *Musa Bakeri*, an allied species; steps have been undertaken for the introduction of true *Musa textilis*.

28. *Asclepias Semilunata* (Kafumbo).—There were grown on the Kampala Plantation two plots of *Asclepias semilunata*; one plot was sown in April, and one in May. The former proved to be more satisfactory and, at a spacing of two feet by one foot, it yielded at a rate of 160 lbs. of floss per acre; samples of the floss were submitted to the Imperial Institute for report (*see* Appendix, page 47).

GREEN MANURES AND COVER CROPS.

29. In June there were received from Moshi, Tanganyika Territory, a consignment of small plants of the following:—

11 *Coronilla varia.*
28 *Lespedeza sericea.*
10 *Lespedeza striata.*
14 *Clitoria cajanifolia.*
10 *Puereria thunbergiana.*

These plants were established in the nursery, Kampala Plantation, but only the *Coronilla varia* and the *Clitoria cajanifolia* made good growth and are being grown on further trial.

30. There have been collected and sown seeds of a number of native plants, which have been considered to show promise of being useful cover crops.

GRASSES.

31. The grass plots on the Kampala Plantation were largely re-planted and other grasses, which are of value for grazing, have been added to the collection.

FRUIT TREES.

32. *Carya pecan* (Pecan Nut).—In October, through the kindness of Mrs. Tothill, there were obtained from Florida seed of three types of Pecan nuts; these seeds were sown in boxes at Kampala, but all failed to germinate. In November, there were obtained from Natal fourteen grafted pecan trees of the following varieties:—

4 Stuart.
4 Moneymaker.
4 Success.
2 Schley.

These trees arrived at the beginning of the dry season, and were planted temporarily near the nursery at Kampala.

33. *Citrus Varieties.*—There were obtained from Australia, *via* Ceylon, a consignment of twenty-six trees of the following varieties:—

2 Natsu Mikaru grape fruit.
2 Triumph grape fruit.
2 Tahitian lime.
2 East Indian lime.
2 West Indian lime.
2 Common lemon.
2 Lisbon lemon.
2 Villa Franca lemon.
2 Jaffa orange.
2 Blood orange.
2 Seville orange.
2 Mediterranean sweet orange.
2 Jacob's Improved Thorny mandarin.

These plants arrived at the beginning of November in excellent condition, and were potted up to be planted out in the rainy season of 1933.

CONCLUSION.

34. For contributions of plants and seeds thanks are due to the following:—

The Department of Agriculture, Tanganyika.
The Department of Agriculture, Kenya.
The Department of Agriculture, Gold Coast.
The East African Research Institute, Amani.
H. D. Hughes, Esq., Florida.

A. S. THOMAS,
Assistant Botanist.

APPENDIX.

IMPERIAL INSTITUTE,
LONDON, S.W. 7.
26TH MAY, 1933.

REPORT ON *ASCLEPIAS* FLOSS FROM UGANDA.

The sample which is the subject of this report was forwarded to the Imperial Institute by the Director of Agriculture and is referred to in his letter No. 927/350, of the 23rd March, 1933.

The material was stated to represent the floss of *Asclepias semilunata*, from plants sown in April and May and thinned to a spacing of 2 ft. by 1 ft., the seed being collected as it ripened in the succeeding months of November, December and January.

DESCRIPTION.

The sample weighed 4 lbs. and consisted of soft, very lustrous, somewhat brittle, straight-fibred floss, which was generally white to pale brown in colour, but some portions varied from a darker brown to greyish-black. The floss had not been entirely freed from seeds, and portions of the seed-capsules were present.

The material was fairly resilient but was inferior in this respect to the floss of *Eriodendron anfractuosum* which is exported from Java under the name of "kapok."

RESULTS OF EXAMINATION.

The fibres possessed the following dimensions, which are shown in comparison with the corresponding figures obtained at the Imperial Institute for a sample of *Asclepias semilunata* floss from India and for genuine Java kapok:—

	Maximum.	*Minimum.*	*Average.*
	in.	*in.*	*in.*
Present sample	1·6	0·7	1·1
Indian *Asclepias* floss	1·7	0·9	1·3
Java kapok	1·1	0·5	0·8

COMMERCIAL VALUE.

The material was submitted to three firms of kapok consumers in London, who reported on it as follows:—

(1) "As regards the possibility of marketing this material, there is no reason why this should not be done as it appears to compare favourably with the similar products from India and China, etc. To-day's value would probably be about 3½d. to 4d. per lb., but it is hardly to be compared with kapok from Java which is a different type of material altogether and which sells at about 6½d. to 7d. per lb. Should the authorities in Uganda desire to offer this material we might be prepared to experiment with it and, if satisfactory, take up the processing of it."

(2) "This fibre is sometimes used as an adulterant for kapok, but there is not a great demand for it as the fibre is very brittle. There is another thing about this sample from Uganda in that its colour is very inferior to that of the floss exported from India which is a very pale yellow or white. We should say that to-day's value of the sample is not more than 3d per lb. *c.i.f.* London. We would appreciate it if you could put us in touch with the shippers, because we would be interested to try a small shipment of it."

(3) "With reference to the commercial value of this material in this country, we do not think there is much value to be attached to it. It is mostly discoloured and same of the fibres seem to be dead. The market for this floss here would depend upon the price and its filling properties in comparison with the prime Java kapok."

Remarks.

Flosses of the type of the present material are employed in the United Kingdom principally as cheap substitutes for kapok in stuffing upholstery. The resilience of *Asclepias* floss is inferior to that of Java kapok and more resembles that of the Indian material known commercially as "Akund," which is the floss of *Colotropis procera* or *C. Gigantea.*

As indicated in the commercial reports quoted above the market value of the floss is much lower than that of Java kapok and it is a question whether a price of 3d. to 4d. per lb. in London would be sufficient to render remunerative the export from Uganda of such a light bulky material. It is undesirable that flosses intended to be used for upholstery purposes should be tightly compressed in bales as this adversely affects their resiliency.

If it is thought that export on the above terms would be possible, small consignments of the floss might be forwarded for trial by the interested firms, together with information as to the quantity which could be supplied annually. It would be necessary to ensure that consignments were free from seeds and broken capsules.

PART V.—BOTANICAL WORK AT ENTEBBE.

STAFF.

Mr. E. A. Ruck was in charge of the gardens until the 17th of November, when I took over the duties; it was not possible to visit Entebbe more than about once a week for the supervision of the work in progress.

METEOROLOGICAL.

2. Meteorological records were obtained from the Geological Department, Entebbe, who have been recording the observations. The total rainfall for the year—70·93 inches—was 11·35 inches more than the average, and was the highest rainfall record since 1926. The wettest month was May, when 16·11 inches of rain were recorded, this figure being 6·96 inches above the average for that month. October was the driest month, when only 1·47 inches of rain were registered, a record 2·47 inches below the average.

3. It would not appear probable that the planting of rubber will again be an economic proposition in Uganda, and work on the crop has been discontinued. Certain of the high yielding trees will be preserved to provide material for propagation, in case that it should be required at some future date.

OIL PALMS.

4. Throughout the year there have been continued the individual records of yields of the trees planted by the Forest Department in 1931. The average number of fruits collected per month was 9,851 and the average weight per month was 387·1 lbs.; the greatest yield was in June when 22,783 fruits, weighing 920 lbs., were harvested.

5. The tree No. 12 continued to be the highest yielder; during the year it produced 4,949 fruits, weighing in all 193 lbs. 7 ozs. There are 106 trees on the plot; eight of them ripened no fruit during 1932.

HYDNOCARPUS.

6. The *Hydnocarpus wightiana* trees planted in 1927 have grown well, and are now about ten feet high; many of them have flowered and are bearing fruit, but none of the fruit has yet ripened. The *Hydnocarpus anthelmintica*, planted in 1929 have grown rapidly, and now average about fifteen feet in height, but no flowers have yet been produced.

FRUIT TREES.

7. During May the following trees were planted in the fruit collection:—

Averrhoa Bilimbi	2	*Achras Sapota*	4
Garcinia Mangostana	1	*Mammea americana*	1
Chrysophyllum Cainito	3	*Castanea vesca*	4
Lansium domesticum var. *duku*	3		

DISTRIBUTION OF PLANTS AND SEEDS.

8. During April, when economic plants and seeds were distributed free, there were sent out the following:—

Avocada Pear	32	Loquat	38
Blackberry	40	Mango	65
Breadnut	17	Mulberry	63
Carambola	22	Orange, Sweet	68
Granadilla	33	Orange, Mandarin	11
Grape Fruit	58	Orange, Marmalade	28
Guava, Apple	29	Orange, Tangerine	60
Guava, Common	9	Papaw	28
Guava, Cherry	9	Pitanga Cherry	76
Guava, Strawberry	11	Pomelo	25
Guava, Friedrichthalianum	6	Pomegranate	13
Jack Fruit	49	Raspberry	96
Lemon, Common	86	Rose Apple	37
Lemon, Smooth Skinned	4	Sour Sop	13
Lime	34		
		TOTAL	1,060

Together with thirteen packets of seeds of various fruit trees.

9. The total number of plants and seeds distributed during the year amounted to:—

	Plants.	*Seeds (packets).*	*Bundles.*
Economic	1,299	13	—
Decorative	9,003	270	17
TOTAL	10,302	283	17

GENERAL.

10. The sloping ground which is above the fruit plot, and which formerly was part of the Forestry Arboretum, was grassed down in January and February, and in March the *Cupressus* hedge was removed. This work has made a great difference to the appearance of the gardens, and the clump of *Cupressus pyramidalis* growing on the top of the slope is now a pleasing feature.

11. An even greater improvement was effected by the removal of the trees of *Hevea* rubber, block No. 2, the levelling of the ground and the planting of grass. This work was in progress throughout the year, and it was not until October that the grass was planted; but it has rendered possible more extensive views of the lake. A number of trees will be planted on this plot, but they will be grouped near the fernery and care will be taken not to obstruct the view.

12. The present nursery site has been used for many years, and it was recommended by Sir Arthur Hill that a new nursery should be made. Accordingly, in July there was selected a plot of ground near the town drain and clearing was commenced; in September a hedge of Mauritius Thorn was sown around this plot. For the remainder of the year the work of removing the Eucalyptus trees was carried on.

13. Towards the end of the year the clearing of the sloping plot above the site of the new nursery was commenced, and the hedge of cinnamon, which divided this plot from the remainder of the gardens, was cut down.

14. It is proposed to re-open the road on the outside of the gardens, along by the lake and up beside the town drain. By the end of the year this road had been cleared, but before it is fit for traffic the culverts must be renewed and the road rebuilt in some places.

15. The routine of re-planting beds with annuals and herbaceous plants was continued, and many of the beds were mulched with leaves and grass. Among the shrubs which were planted out were *Lonchocarpus* sp. and Bougainvillea Mrs. Butt.

INTRODUCTIONS.

16. The plants raised from seed imported during the year included:—

Myroxylon toluiferum.
Cedrela odorata.
Eugenia floribunda (red and yellow fruited varieties).
Schizolobum excelsum.
Ipomoea arborescens.
Cassia tomentosa.

A. S. THOMAS,
Assistant Botanist.

REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR 1932.

STAFF.

Mr. G. H. E. Hopkins, Medical Entomologist, was transferred to the section and was appointed Entomologist on January 1st. Mr. T. W. Chorley, Laboratory Apprentice, also was transferred to the entomological section from the Medical Department.

H. D. Mubiru, Native Agricultural Assistant, was appointed to the section early in January. The Government Entomologist resumed charge of the section on January 20th on return from leave. The Entomologist and the Laboratory Apprentice took local leave respectively for the periods February 15th—March 14th, and March 29th—April 12th; they departed on home leave respectively on the 19th and 22nd of December. The Laboratory Assistant continued work with the section until July 23rd, when he returned for duty to the Medical Laboratory. The Assistant Entomologist was on duty the whole year excepting two periods of illness.

INTRODUCTION.

This report is divided into four parts:—

Agricultural.—Comprising sections on Locusts, Cotton, Coffee, Other Crops, Plant Imports and Capsidae;

Medical.—Mosquito Surveys, General Mosquito Investigations, Tsetse Flies, Simulium Flies, House Flies and Sand Flies, Rats and Fleas, and Ticks;

Bees;

General.—Publications, and Acknowledgments.

AGRICULTURAL.

LOCUSTS.

The infestation by *Locusta migratorioides* continued throughout the year but on a scale far less intense and much less widespread than during the previous year. The second generation towards the end of the year was much reduced and there was a general tendency towards diffuse egg-laying and small bands of hoppers. Damage to susceptible crops, caused chiefly by fliers, was negligible in most districts, and in no area was any serious shortage of food due to attack by locusts. Reports summarising the position were compiled weekly; these were published by the local press. Similar reports covering monthly periods were written and the activities of locusts recorded in detail on maps for the information of officers investigating the locust problem.

COTTON.

Platyedra gossypiella, Saund. (Pink Bollworm).—This insect has extended its range southward to the ginneries at Rhino Camp and Minakulu; the extension has been accelerated by the movement of seed cotton, but there are indications of a slow natural spread. The pest has not yet crossed the non-cotton zone designed to isolate Gulu District, but it is probable that the gap in the barrier at the Aber bridge will allow *Platyedra* to spread into Lango shortly. The parasite *Microbracon kirkpatricki* has been found in Gulu District, but so far the degree of parasitisation appears to be low.

The total damage by pink bollworm in Gulu and East Madi has been low, especially when compared with the damage caused by stainers. An examination towards the end of the picking season disclosed about 10% damage caused by bollworms to crop still on the plants and 50% damage caused by internal boll-disease associated with stainer-punctures. These figures were obtained from 750 bolls, collected from 13 different plots. The same percentage of stainer-damage was found in a sample of 200 bolls collected outside the infested area. It is of interest to record that in the area infested with pink bollworm there was an apparent absence of *Argyroploce leucotreta* from places where the latter had been found in 1931. Whether the one insect is in any way antagonistic to the other is not clear; in Egypt, similarly, the advent of pink bollworm was found to be associated with a decrease in the number of spiny bollworm attacking cotton.

Food-plants of pink bollworm have been found to include "okra" (*Hibiscus esculentus*), though this plant was but lightly infested. There is still no indication that the larva can aestivate, and the survival of pink bollworm during the close season appears to depend mainly on the presence of living cotton plants. It is therefore essential that action be taken to ensure a complete absence of growing cotton between the seasons.

The three species of *Platyedra* occurring in Uganda have been critically examined; the males are very easily separable by examination of the genitalia. The larva of *P. cuncatrix* can be distinguished from the other species of *Platyedra* by the fact that the setæ arise from small plates as in *Argyroploce*. The complete circle of more numerous crochets on the prolegs of *Argyroploce* and the presence of an "anal fork" serve to distinguish it from *P. cuncatrix*, the diffuse pink colour of which resembles some forms of *Argyroploce*. *P. cuncatrix* has so far not been found on cotton, neither has *Argyroploce* been found in wild species of *Hibiscus*.

Jassid Bug (*Empoasca fascialis*).—The experiment at Kampala to test the influence of a dry hill-side environment (poor shallow soil) as against a moist valley environment (deep and richer soil) was repeated, using seed taken from last year's plots of Delerect cotton. The results of last year's work were confirmed, the Jassid population of the higher plot being considerably the higher until after harvest, when an apparent increase occurred on the lower plot. This was partly counterbalanced by the larger size and smaller number of the leaves of

the lower plot, the basis of records being the number of Jassid nymphs per ten leaves. The cotton plants of the upper plot were very severely damaged by *Helopeltis* while only one plant in the lower plot was attacked. This single moderately damaged plant shewed no greater Jassid population than the others and there is therefore no indication that the denser Jassid population of the higher plot was consequent on attack by *Helopeltis*. It was not possible to find any indication of a correlation between hairiness and Jassid prevalence; the variation in hairiness among plants of this variety is, however, comparatively small. The conclusion is that soil and water supply and, or, possibly microclimate are the determining factors; a drought-resistant strain of cotton appears more likely to escape damage by Jassids than one which is susceptible to drought.

Helopeltis.—Damage by *Helopeltis* has been noted to an unusual degree during the past season. It is not possible to decide whether any actual increase of this insect has occurred because of past confusion of its damage with " angular leaf-spot " and " black-arm " disease. (It is stated that in Nigeria all *Helopeltis* damage was formerly attributed to " black-arm.") It is probable that this insect is responsible for more damage than was previously considered to be the case. The following notes are given to facilitate differentiation of *Helopeltis* damage from that of *Bacterium malvacearum*:—

Angular Leaf-spot.	Helopeltis.
Spots water-soaked, shallow.	Spots on leaf not water soaked, more sunken.
Old spots sometimes slightly visible from upper side.	Old spots brown, easily visible from upper side.
Leaf normal green colour.	Leaf dark green and sometimes a little reddish near veins.
Veins normal.	Veins often sucked, brown or reddish.
Black-arm.	
Lesions when young, unhealthy within, wood grey-green, tending to be slimy or moist.	Lesions often very superficial when young.
Foliage not bunched.	Plant with bunchy growth, often much dwarfed.

(Old damage to stems cannot be differentiated).

It has been stated above that intense damage by *Helopeltis* occurred on one of the plots laid down for the observations on Jassid bugs, and not on the other. Comparison of root-systems of plants from the two plots shewed that there was little development of secondary and tertiary roots of the plants of the lower plots while those of the upper plot exhibited such development in an unusual degree. The soil of the upper plot was very shallow and had long been subjected to erosion, and it would appear that the increase of the absorptive surface and of lateral roots was directly correlated with the difficulty of obtaining water.

A report by the Agricultural Officer, Bululu, that some June-sown cotton was suffering during December from attack by *Helopeltis* as well as Jassid bugs whereas some August-sown plants of the same strain growing within sixty yards were free from both pests, led to the suggestion that examination of the root-systems might afford some clue to causal factors. It was found that the attacked plants had shorter tap-roots and systems of laterals practically confined to the top six inches of soil, as opposed to tap-roots averaging seven inches longer and laterals distributed to a depth of fifteen inches from ground-level in the case of the plants from seed sown two months later. The crop, picked or in sight, reflected the root-systems, averaging 3·3 as against 6·9 bolls for the later-sown plants. It would seem that some factor or factors such as rainfall-distribution and, or, cultivation restricted root-development of the June-sown cotton at a critical stage, and by thus affecting the health of the plants made conditions favourable for breeding of the two pests mentioned.

Observations in other areas regarding incidence of *Helopeltis* attack on cotton resulted in the following notes. In Busoga, west of Terinyi, damage was most marked in the drier areas. At Agoro (Chua) plants in depressions where there may earlier have been a tendency to waterlogging shewed damage, whereas tiny plants on mounds of dry soil shewed none; plants in intermediate situations were producing very good crops. At Agoro the damage coincided with a change of seed-supply but it is questionable whether this factor influenced the situation, though at Agoro the natives stated definitely that no noticeable damage had occurred in previous years. No marked damage was noted in the drier parts of Teso, from Mukongoro to Soroti; it is possible that lack of succulent food resulting from the long dry season combined with extensive grass-fires may cause almost complete extermination of *Helopeltis* in drier areas.

There are indications that *Helopeltis* is primarily a forest insect; observations have shown that it subsists and breeds on a large number of very varied types of plants, the essential condition being succulence. The prevalence of this bug in all stages on sweet-potato at Bukalasa Experiment Station during November suggests that an increased prevalence on cotton in certain areas may have occurred owing to the extended cultivation of sweet-potato as a supplementary food supply to replace millets (an anti-locust measure).

The life-history and habits of *Helopeltis* have been studied in detail and this work is being continued. A full account will be given in due course.

Lygus vosseleri.—Work has been continued on the damage caused by this insect and the observations made over a number of years have been confirmed. The insect definitely is able to affect the growth of the plant and thereby to reduce its yield in addition to reducing yield by the direct damage to young bolls.

Plants caged when 18 inches high under cotton mosquito-gauze and examined when 40 inches high gave the following results. Unfortunately, in one or two cases, the supply of insects was apparently not kept up. A further possible source of error is the natural variability of the cotton and it is hoped to use a more uniform strain next season.

Plants with *Lygus*.					Controls (No *Lygus*).				
Plant No.		*No. of nodes.*		*No. of Fruits.*	*Plant No.*		*No. of nodes.*		*No. of Fruits.*
1	...	22	...	3	5	...	16	...	10
2	...	24	...	6	7	...	18	...	12
3	...	19	...	6	9	...	51	...	44
4	...	36	...	2	10	...	45	...	43
6	...	42	...	15	11	...	25	...	19
12	...	17	...	2	13	...	41	...	41
					14	...	41	...	37
					15	...	36	...	19
Averages		26·7	...	5·7		...	34·1	...	28·1

Plants on which practically no feeding took place:—No. 16—54 nodes, 35 fruits; No. 8—36 nodes, 29 fruits.

From general observations it appeared that the control plants were slightly more fortunate in their soil environment. Numbers 12 and 13 were contiguous and appeared to have the same chances; No. 12 showed very extensive signs of feeding and extremely intense damage. The results verify previous field observations, namely, that the effects of *Lygus* feeding on the vegetative parts of the plant are loss of fruits, less free branching, and more secondary branching (induced by retardation or cessation of growth at the apices of the primaries).

Plots of cotton were grown at Serere, Bukalasa and Kampala to endeavour, by spraying, to obtain plants free from *Lygus* without subjecting the plants to the etiolating effect of caging which, moreover, increases the *Aphis* population by excluding predators and which itself may induce some boll- or bud-shedding. The sprayed plants at Kampala were kept free from *Lygus*, but since only very few plants were attacked, and slightly, in the control plots no definite results were obtainable. Severe damage was noted on the sprayed plots at Bukalasa; at Serere only was a clear difference demonstrable.

At Kampala a number of plants were kept under observation and counts of *Lygus*-damaged leaves were regularly made in an attempt to estimate damage quantitatively. It was not a success, but it shewed that great care must be exercised to avoid misleading conclusions from apparently-significant quantitative results.

It is of interest to record that *Lygus* leaf-damage has been observed in the field to be connected in some way with rainy weather. The control plots for the spraying at Kampala were in the damper situation of the swamp, and *Lygus*-damage, as stated above, was practically nil; the observation plants on the other hand were growing on higher ground where a considerable amount of *Lygus*-damage developed. Microclimate was not therefore indicated as a factor of greater importance than macroclimate, a point previously noted when making field observations.

The study of the relationship between sowing-dates and weather over a wide range of soil conditions would appear to be the line of work most promising for the reduction of the heavy loss caused by *Lygus vosseleri*.

The Capsid bug *Deræocoris* sp. (nymph with a red " tail ") found on cotton has proved to be predaceous on aphids, while *Geocoris amabilis* has been confirmed as a predator—in the laboratory it fed eagerly on adults and nymphs of *Megacoelum* and *Deræocoris*.

A preliminary trial of a poison-bait spray against *Dysdercus* gave very promising results, even during showery weather. The bugs (nymphs and adults) were immediately attracted to the droplets of bait and death of most of the cotton-stainers occurred within two days of application. A second application was given after an interval of nine days when relatively few and mainly adult *Dysdercus* were present; these probably were immigrants, or they may have been full-grown nymphs which had ceased temporarily to feed prior to the final moult at the time of the first baiting. It is of interest to note that adult *Helopeltis* and *Megacoleum* (which was rare) were observed to feed immediately on the bait and that several of the first-named Capsid were collected as dead; also, Jassid adults appeared to imbibe the bait. This appears to be a promising line of experiment for control of various sucking insects, including *Lygus*, in areas where spray-baiting is feasible, and it is intended that further tests shall be carried out during the next cotton season.

COFFEE.

Work carried out on coffee insects included the following:—

(*a*) Comparative studies of the life-histories of the two *Antestia* species *lineaticollis* and *faceta*, and of the influence, on their rate of growth and on reproduction, of restriction of food to that derivable from vegetative parts as opposed to a food supply inclusive of berries.

(*b*) The bionomics of the Tingid bug, *Habrochilus placida*.

(*c*) Further enquiry into the possible causes of flower-bud abortion. The evidence obtained indicates that insects are not implicated as a cause of the type of bud-abortion under consideration but that the abortion is a result of starvation of buds caused by some factor, or combination of factors, such as weather, soil and cultivation.

(*d*) Investigation of damage caused by the Capsid bug, *Volumnus obscurus*. The damage to flowers is identical with that due to attack by *Lygus simonyi*.

(*e*) The breeding of parasites of *Stephanoderes* for their introduction into Bwamba (between Ruwenzori Mountains and the Belgian Congo escarpment) where such parasites apparently did not occur naturally.

Three consignments of material containing many *Heterospilus* were shipped to Java whose Government wish to introduce this parasite. The attempts failed, apparently owing to the fact that *Heterospilus* is a free-living insect—the adult does not continue to live in borer-infected berries as does the adult *Prorops*.

(*f*) The binomics of the stem-borer, *Dirphya*.

(*g*) The habits and control of a fierce species of leaf-nesting black ant which in some instances prevents the crop being picked.

(*h*) An experiment, designed to determine the influence of the health of coffee trees, as affected by various methods of planting, on the incidence and prevalence of scale- and other sucking-insects, was laid down at Kampala. All plants were put into the field personally by the Government Entomologist to ensure the required treatment of the root-systems.

(*i*) Nineteen visits were paid to non-native estates.

OTHER CROPS.

Ground-nut.

A survey of insects occurring on this crop was commenced. The following species were found:—*Aphis laburni*, Kalt. (with one species of hymenopterous parasite and three species Syrphid predators); two species Capsidæ; Jassid bugs; an Aleurodid bug, *Piezodorus pallescens*, Germ,; *Luperodes quaternus*, Fairm. (Galerucid beetle); *Tortrix dinata*, Meyr., *Maruca testulalis*, Hub., and *Prodenia litura*, Fab. (all three, leaf-eating caterpillars); and a species of thrips attacking the leaf. The only insect of serious importance appeared to be the aphid, which is the proved vector of " rosette " disease.

Plots of ground-nuts were grown during the early rains in the drained part of the swamp, where the water-table was fairly high, and on a higher, much eroded area of poor soil. Observations shewed an earlier and more severe incidence of rosette disease on the higher plot on which also the general effect of an early dry period (commencing late in May) was indicated by cessation of flowering, the prevalence of leaf-spot and the occurrence of a wilt disease; the plants of this plot dried up and such crop as had been produced was harvested early in July, whereas those of the swamp plot continued generally healthy and were still producing crop at the end of July despite continued dry weather. The crops of the two areas were not measured, but the yields from plants on the lower area must have been far in excess of those on the higher area. It is of interest to note that while adults of both Jassid and Aleurodid bugs were not uncommon on both plots during the middle period of growth, very few nymphs were to be found at any time during the observations.

Banana.

A preliminary study was made of the ecology of the weevil *Cosmopolites*, a special opportunity being afforded by the abandoning of a number of gardens close to others still under cultivation. In the abandoned area, although old weevil-workings were abundant and indicated very severe attack, the beetle itself was practically absent and young suckers were all quite healthy; nests of small ants were not uncommon under the outer layers of the old pseudo-stems, but other possible predators comprising Histerid, Staphylinid and Hydrophilid beetles were rare. In the area under cultivation, weevil-damage though not extensive was mainly recent, and there was a greater prevalence of *Cosmopolites* larvæ and adults in living plants and of the larger Histerid beetles in decaying cut pseudo-stems. This study will be continued.

Stored Foods.

A survey of insects in seeds, comprising maize-meal, rice, ground-nut and beans stored as food for labour and prisoners, was carried out, and experiments were conducted with safe and easily applied fumigants with a view to prevention of damage by such insects.

Various.

Whenever opportunities have occurred observations have been made on the insects present on other crops, including tea, sim-sim, sweet-potato, maize, millets, pigeon-pea, beans, cover-crops, essential-oil plants and edible fruits. This forms part of the routine of officers both at headquarters and on tour.

Plant Imports.

Packages of imported plants totalling 143 were examined. Eighteen packages of seeds were fumigated for export.

Capsidae.

In view of the increasing importance of bugs of this family in relation to crop-production in Uganda, and of the difficulty (often the impossibility) of obtaining specific identification of these insects, it has been considered desirable to make a study of the systematics of this difficult group. With this end in view these insects have been specially collected, as opportunities occurred, from both cultivated and indigenous plants, and material sufficient as a basis for study has been accumulated. Much leisure time has been devoted to studying the classification and to the interpretation of specific descriptions.

BEES.

A. Honey Bee.

The hives of bees at the Government Plantation, Kampala, were taken over from the Coffee Officer by the Laboratory Apprentice early in March, 1932. These hives comprised ten of the petrol-box type and one of the basket-work type without queen-excluder. It was not until the second half of the year that regular attention could be paid to the hives and experimental work became possible. The existing petrol-box hives were considered too elaborate and expensive for general use in this country; investigations were therefore directed mainly towards evolving a simple type of hive which could be made from common materials without cost other than labour, and which when fitted with a very cheap form of queen-excluder would enable clean wax and honey to be produced.

In designing hives reference was made to the type advocated by Mr. H. H. King for use by natives in the Sudan. The main differences of the Uganda type are in the materials used for construction, the container being of elephant-grass stems, papyrus, bark or split bambo and the queen-excluder of coffee-tray wire.

A native member of the staff was trained to construct and to site hives and he has demonstrated these at Kabale, Mbarara, and Adumi (West Nile). Hives for experiment have also been sent to the Agricultural Officer (Education) at Serere and to Mr. W. L. Munn at Bubulu. In areas where conditions are suitable, such as Gulu and Ankole, considerable interest has been taken in the subject of apiculture. Three students in agriculture from Makerere College also received training as outlined above; it has been arranged that a short course of instruction will be given to Native Agricultural Instructors and to students from Makerere during 1933.

A circular, based on the results of experiments and enquiries, has been prepared for the guidance of natives and the stimulation of interest in bee-keeping; the construction of the hives will be illustrated by drawings, and it is proposed that the text shall be printed in Luganda, Swahili and English.

B. Stingless Bees.

With a view to their utilisation for pollination of clones of selected coffee trees for the Assistant Botanist, experiments were carried out to ascertain whether colonies of stingless bees would live sufficiently long, under the somewhat artificial conditions involved, to perform the required task. *Melipona denoiti*, a small stingless species, was observed to visit coffee flowers, and its nests were found commonly in termite hills. Complete nests were dug out and transferred to portable containers and eventually it was found possible to keep the bees alive for at least a month by placing the nests in a sufficiently cool situation.

MEDICAL.

A full report on the medical work of the entomological section will be found in the Annual Report of the Medical Department. The report describes the work carried out under the headings—

Mosquito Surveys. General Mosquito Investigations. Tse-tse Flies. Simulium Flies. House Flies and Sand Flies. Rats and Fleas. Ticks.

GENERAL.

Publications.

Mr. Hopkins has contributed to a monograph of the Ethiopian Culicidæ to be published by the British Museum.

The following papers by Mr. Gibbins have been published in the Annals of Tropical Medicine and Parasitology:—"Natural Malaria Infection of House-Frequenting *Anopheles* Mosquitoes in Uganda" (XXVI, p. 239, 1932); "A Note on the Relative Size of the Anal Gills of Mosquito Larvæ Breeding in Salt and Fresh Water" (XXVI, p. 551, 1932); "The Domestic *Anopheles* Mosquitoes of Uganda" (XXVII, p. 15, 1932).

Two further papers by Mr. Gibbins—"Studies on Ethiopian Simuliidæ I, *Simulium damnosum*, Theo.", and "Eggs of some Ethiopian *Anopheles* Mosquitoes"—have been accepted for publication.

While all the above papers were based on work done during secondment to the Entomological Section, several were offered for publication after Mr. Gibbins returned to the Medical Department.

Circulars for local use, both general and in schools, on bee-keeping and on mosquitoes have been prepared for publication.

Acknowledgments.

Mr. J. F. Shillito has contributed numerous specimens for the collection, together with notes on their biology.

Mr. G. W. Eggeling of the Forestry Department has given similar assistance.

As in previous years, the Imperial Institute of Entomology has been of great assistance in various ways.

The following systematists have identified insects for the collection:—

D. Aubertin, H. F. Barnes, M. Bernhauer, K. G. Blair, H. Blote, A. Boucoumont, L. Burgeon, W. E. China, T. D. A. Cockerell, C. L. Collenette, J. B. Corporral, H. Desbordes, F. W. Edwards, H. Eggers, E. O. Engel, A. M. Evans, R. Forsius, J. J. E. Gillet, R. F. Heberday, F. Hendel, M. Hering, T. Jaciewski, R. Klein, S. Maulik, M. E. Moseley, G. Ochs, J. Omer Cooper, M. Pic, A. E. Prout, L. B. Prout, P. Sack, V. G. L. Van Someren, F. Spaeth, W. H. T. Tams, A. Thery, and G. B. Thompson.

H. HARGREAVES,
Government Entomologist.

ANNUAL REPORT OF THE MYCOLOGIST, 1932.

I was absent from the Protectorate on leave in England for the period February 20th to September 15th.

2. While on leave I worked at the Imperial Mycological Institute and the Herbarium, Royal Botanic Gardens, Kew, for over two months in an endeavour to identify the collections of Uganda fungi which I had made during the past few years. Considerable progress was made in this work, and material for a series of papers on some groups of Uganda fungi has been accumulated. This will be published as it can be written up. An account of the Uredineæ of Uganda is in the press, written in collaboration with Miss E. W. Wakefield, of the staff of the Kew Herbarium.

3. Two visits were paid to the Rothamsted Agricultural Experiment Station in connection with experimental work in Uganda on the Blackarm Disease of Cotton. The results of the 1931-32 programme were worked out in collaboration with the workers there, and a detailed account of the results will appear shortly in the Annals of Applied Biology. Necessary modifications in the 1932-33 programme were discussed in the light of the results obtained from the previous season's experiments, and were forwarded to Uganda in time for the 1932 planting season.

4. On my return from leave I took charge of the Blackarm experimental work at Serere Plantation, which has occupied almost the whole of my time up to the end of the season. An account of the results obtained from these experiments is included in the Appendix to this report.

5. An examination of the cotton breeding plots at Serere and Bukalasa was made with the object of obtaining comparative data on the resistance of some of the more promising of the new strains of cotton to Blackarm. Some of these strains show signs of considerable promise in this respect, several of the strains at Serere being very much more resistant to the disease than S.G. 29, the variety which is being extensively grown in the Eastern Province at present.

A decimal scale was used in this examination so as to obtain a definite measure of the amount of disease present on the different strains of cotton. The average values on this scale for some of the strains examined are given below; for index purposes the figure 1·00 indicates that a trace of infection was present, 2·00 indicates slight infection, 5·00 approximately half the leaves so heavily infected as to impair their activities, 10·00 indicates complete death of the plant. These figures apply to leaf infection, the figures given in the column below for stem infection represent the average number of lesions per plant. A minimum of 40 plants of each strain were examined.

Strain.	Number of Plants.	Index of Leaf Infection.	Stem Infection.
SP. 20	43	1·94	0·33
SP. 21	44	1·66	0·09
SP. 22	44	2·09	0·21
SP. 29	46	4·04	1·76
SP. 34	45	2·19	0·30
SP. 35	48	3·00	1·15
SP. 36	44	2·00	0·32
X. 4	22	5·27	6·64
Records from other plots:—			
SP. 20	96	1·91	
SP. 21	108	1·97	
SP. 35	125	2·50	

Of the above strains SP. 20, 21 and 22 are derived from U 4.4.2 through the strain SP. 13; SP. 29 is a derivative of SG. 29; SP. 34, 35 and 36 are selections from the progeny of a single plant discovered in Usuku which produced a good crop in the year 1930 when the cotton in this area suffered very severely from Blackarm; X 4 is from Punjab American.

6. As the programme of observation work on the Blackarm experiments detailed in the Appendix occupied almost the whole of my time after my return from leave, work on the diseases of other crops has been limited to examination of specimens collected or received from time to time—

The cover crop *Dolichos lablab* suffered very severely from attack by a fungus at present unidentified but probably related to *Sphaceloma citri* causing the scab disease of *Citrus*. Many of the plants were killed off completely, and most showed very severe damage to the foliage and other aerial parts. Affected plants produced very little seed. A number of seedlings of the Shea butternut, *Butyrospermum*, died off some months after planting; examination showed that a number of common soil fungi were present, but the cause could not be determined.

Lucerne suffered severely at Serere from the rust *Uromyces striatus;* also a considerable proportion of the plants were killed by *Sclerotium Rolfsii*. It would appear that this crop is not likely to be of much value in Uganda.

7. *Sugar.*—On my journey back from leave arrangements were made with the Mycologist in Charge of the Durban Herbarium for supplies of certain varieties of cane resistant to Mosaic Disease to be forwarded to Uganda for trial here.

The following figures on the sugar production of some of the varieties of cane now being grown in Uganda have been supplied me by Mr. R. B. Patel of the Uganda (Kakira) Sugar Works, Ltd. Although the figures were taken from single plots and not from a replicated variety trial, they are of interest in being the first obtainable here on the comparative yields of the different varieties.

Variety.	Tons Cane per acre	Age, months.	Sucrose.	Purity.	Sucrose per acre in tons.
POJ. 2727	65·05	16	14·691	85·11	9·557
POJ. 2725	64·28	17	15·03	81·81	9·661
BH. 10/12	51·52	17	18·175	92·25	9·3638
BA. 11403	45·30	17	15·97	84·10	7·2344
BA. 8409	49·92	17	15·01	87·47	7·4930
D. 109	58·75	17	14·062	82·91	8·2614
Striped Ribbon	52·42	17½	14·97	87·32	7·8473

The rainfall during the growth period was 53·00 ins. for POJ. 2727, and 58·15 ins. for the other varieties, which were cut in October, a month later than POJ. 2727.

8. Collection of specimens of Uganda fungi has been continued whenever possible, and a number of rusts new to this flora were forwarded to Kew for identification.

9. I am greatly indebted to the Directors of the Imperial Mycological Institute and the Royal Botanic Gardens, Kew, for affording me facilities for work at their institutions during my leave; and especially to Mr. E. W. Mason and Miss E. M. Wakefield for great help in the identification of Uganda fungi; also to the following specialists for help in certain groups: Prof. Charles Chupp, Prof. F. L. Stevens, Prof. J. Weese and Herr H. Sydow.

C. G. HANSFORD,
Mycologist.

APPENDIX.

BLACKARM RESEARCH, 1932-33.

All the experiments detailed below were designed with the help of Messrs. Nye and Hosking of this Department, and of Messrs. Fisher, Stoughton and Yates of Rothamsted Agricultural Experiment Station.

2. I am greatly indebted to Mr. Hosking for help in the statistical analysis of the results.

3. The experiments were designed with the object of obtaining information in a form capable of statistical analysis on the following points:—

The rate of spread of the leaf form of the disease, and its correlation with meteorological conditions prevailing at the time; and on

The damage to crop production caused by the various forms of the disease.

4. Experiments I and II were carried out at both Bukalasa and Serere Plantations. Experiment III being carried out at Serere only. The set of experiments at Serere were laid down by Mr. Hosking, prior to my arrival from leave; while those at Bukalasa were carried out by Messrs. Irving and Nye.

EXPERIMENT I.

Objects.—To study the effect of various seed treatments on the amount of Angular Leaf Spot and Black Arm in the resulting crop; also the effect of these seed treatments on the yield of cotton.

Lay-out.—The experiment was carried out at both Bukalasa and Serere and at each centre it consisted of two Latin Squares side by side, each containing 16 sub-plots. These sub-plots were separated from each other by a strip of Sunn Hemp to act as a check to the spread of disease from plot to plot.

Four treatments were used, as follows:—

S. Seed delinted with sulphuric acid and then treated with corrosive sublimate solution under vacuo, to aim at complete removal of *B. malvacearum* from the exterior of the seed.

C. Control, seed untreated.

I. Seed soaked in a culture of *B. malvacearum*.

D. Seed dusted with Dupont "Granosan."

History—Serere.—The plots were each of 280 holes, at 3 ft. by 1 ft. spacing, and sowing took place on August 17th. Blanks were resown on August 30th. On September 13th, a very severe hail storm did considerable damage to the plots, causing a large proportion of deaths of the young plants. A second resowing was made on 15th September to fill blank holes, but the resulting plants did not make good growth. Many of the plants damaged from hail died after this when it was too late in the season to replant blank holes with any prospect of success. In consequence the stand in the whole experiment was rather poor. The crop was harvested and the plants uprooted on February 25th.

Bukalasa.—The plots were each of 408 holes at 3 ft. by 1 ft. spacing; they were sown on 6th August and harvested up to the middle of March, when the plants were uprooted.

Results.—

(a) Germination.

1. *Serere.*—Count made 29th August.

Treatment Means.

S	...	111·00.	*I*	...	117·75.
C	...	102·13.	*D*	...	170·25.

Plan of Experiment.

S 109	C 100	I 146	D 207	C 116	D 142	I 83	S 119
I 99	D 201	S 131	C 134	S 135	I 107	D 166	C 91
D 173	S 90	C 97	I 148	D 159	S 88	C 79	I 107
C 91	I 128	D 171	S 97	I 124	C 109	S 119	D 143

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z.*"	"*Significance.*"
Total	31	1113·9506		
Squares	1	1725·7813		
Rows	6	505·5833		
Columns	6	312·6666		
Treatments	3	7517·5324	1·42455	100 : 1
Error	15	356·3060		

Least significant difference between two treatment means is 20·112.

Conclusion.—Treatment D (dust) shows significantly better germination than the others, the differences between which are not significant.

2. *Bukalasa.*—(Count made 24th August).

PLAN OF COUNT.

C 290	D 368	I 151	S 350	S 346	C 236	I 299	D 273
I 118	S 337	D 358	C 260	I 137	D 288	S 260	C 255
S 348	I 122	C 261	D 344	C 244	S 289	D 305	I 123
D 315	C 252	S 364	I 131	D 340	I 115	C 189	S 311

TREATMENT MEANS.

S	...	325·6.	*I*	...	149·5.
C	...	248·4.	*D*	...	323·9.

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	"*z.*"	"*Significance.*"
Total	31			
Rows	6	1536·5		
Columns	6	680·2		
Squares	1	3402·5		
Treatments	3	55249·2	1·80036	100 : 1
Error	15	1508·8		

Least significant difference between two treatment means is 41·34.

Conclusion.—Both the sterilised (*S*) seed and the dusted (*D*) seed germinated significantly better than the control untreated (*C*) seed; this in turn germinated better than the inoculated seed.

3. *Combined Analysis of Both Centres.*

	Degrees of Freedom.	*Variance.*	"*z.*"	"*Significance.*"
Total	63			
(Centres)	(1)	(298,389·06)		100 : 1
Squares	3	105,189·08		
Rows and Columns	24	758·74		
Treatments	3	43,289·58	2·68294	100 : 1
Treatments × Centres ...	3	26,202·52	2·33190	100 : 1
Error	29	198·29		

Least significant difference between two treatment means is 10·2.

TREATMENT MEANS.

S	...	218·3.	*I*	...	133·6.
C	...	175·3.	*D*	...	247·1.

Conclusion.—Germination of the seed is improved by dusting, and to a lesser extent by the processes used in this experiment for exterior sterilisation; on the other hand it is reduced by inoculation with *B. malvacearum.*

The interaction between treatment and centre is very significant, and is due to the different order of the treatments in terms of relative germination at the two centres:—

At Serere the order is *D* (largest), *I*, *S*, *C* (lowest);

At Bukalasa the order is *D* (largest), *S*, *C*, *I* (lowest).

(b) Stand Counts—Serere, 13-9-32, and Bukalasa, 7-9-32.

Serere.—

S 137	C 203	I 209	D 254	C 195	D 224	I 171	S 165
I 194	D 215	S 180	C 231	S 177	I 170	D 207	C 178
D 227	S 249	C 193	I 208	D 228	S 152	C 163	I 190
C 182	I 191	D 245	S 225	I 177	C 181	S 180	D 196

Bukalasa.—

C 378	D 401	I 305	S 382	S 371	C 358	I 353	D 405
I 278	S 352	D 406	C 373	I 316	D 406	S 374	C 379
S 357	I 279	C 348	D 395	C 351	S 313	D 333	I 210
D 392	C 341	S 379	I 281	D 402	I 279	C 303	S 332

Treatment Means for Both Centres.

S	...	270·3.	*I*	...	238·2.
C	...	270·3.	*D*	...	308·5.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	63			
Squares	3	123725·02	1·82656	100 : 1
(Centres)	(1)	(365571·39)	(2·36909)	100 : 1
Rows and Columns	24	937·41		none
Treatments	3	13216·35	1·70907	100 : 1
Treatments × Centres ...	3	4940·60	1·21711	100 : 1
Error	30	433·124		

Least significant difference between two treatment means is 15·7.

Conclusion.—The dust treatment (*D*) of the seed has resulted in a better stand than the untreated seed (*C*); inoculation of the seed (*I*) has lowered the stand; while there is no difference between the stand from the sterilised seed (*S*) and the control.

The differences between the treatments are less in this count than those of the previous count, owing to the resowing of blank holes and possibly also to delayed germination of some of the original seed.

(c) Final Stand at Time of Uprooting (17-2-33).

Serere.—

S 104	C 128	I 151	D 176	C 156	D 180	I 130	S 145
I 111	D 163	S 117	C 197	S 152	I 143	D 153	C 148
D 156	S 112	C 130	I 154	D 181	S 150	C 143	I 165
C 103	I 115	D 138	S 144	I 140	C 154	S 148	D 149

Treatment Means.

S	...	134·00.	*I*	...	138·63.
C	...	144·88.	*D*	...	162·00.

Unfortunately no figures are available for the final stand at Bukalasa.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	31			
Squares	1	1770·125	1·06596	100 : 1
Rows	6	226·063	—	none
Columns	6	982·896	0·78150	100 : 1
Treatments	3	1201·583	0·87191	100 : 1
Error	15	205·925		

Least significant difference between two treatment means is 15·28.

Conclusion.—The dusted seed has given a better stand than any of the other treatments, the differences between which are not significant. The advantage due to dusting has persisted throughout the season, and amounts to 12·6% of the stand of the untreated plots.

(d) Infection on Leaves on September 26th at Serere.

No. of Plants Infected:—

S 0	C 5	I 75	D 13	C 45	D 12	I 82	S 26
I 38	D 26	S 9	C 20	S 14	I 71	D 0	C 41
D 4	S 5	C 12	I 50	D 21	S 19	C 30	I 122
C 19	I 76	D 17	S 44	I 42	C 53	S 84	D 47 (D 124)

Note.—The heavy infection in the D plot in the lower right hand corner of the above plan is attibuted to heavy surface wash during rain storms passing through this plot after having been contaminated with *B. malvacearum* from plots higher up the slight slope. In general the wash took place along the long axis of the experiment from left to right in the plan; though plots in the third row (D 4 to C 30) escaped, while the last plot (I 122) in this row received some of the wash from the bottom row. In consequence of the great divergence of the plot D 124 from the mean for treatment D, it has been omitted from the following analysis, and an estimate (D 47) has been substituted, according to the method of Allan and Wishart (Journ. Agric. Science XX, p. 399, 1930).

Treatment Means.

S	...	25·125.	*I*	...	69·50.
C	...	28·125.	*D*	...	17·50 (modified as above).

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	30 (31 less 1 for the calculated plot).			
Rows	6	411·313		
Columns	6	350·146		
Squares	1	2113·000		
Treatments	3	4377·042	1·06901	100 : 1
Error	14	516·00		

Least significant difference between two treatment means is 24·37.

Conclusion.—The inoculated plots show more infection than any of the other treatments; the differences between these latter are not significant.

(e) Leaf Infection at Bukalasa on November 7th.

Expressed as percentage of number of plants in each plot (counted on 7-9-32) showing leaf infection:—

C 46·3	D 12·2	I 23·3	S 8·1	S 16·4	C 25·7	I 37·3 (I 60·3)	D 15·3
I 28·8 (I 8·3)	S 12·8	D 6·4	C 25·2	I 36·4	D 6·9	S 11·5	C 38·3
S 8·1	I 16·1	C 22·4	D 7·8	C 33·3	S 2·9	D 15·9	I 34·3
D 8·9	C 24·0	S 5·5	I 19·2	D 10·4	I 26 9	C 24·8	S 3·6

Note.—The two plots I 8·3 and I 60·3 have been omitted from the following analysis and the values I 28·8 and I 37·3 substituted for them, calculated according to the method of Allan and Wishart (*loc. cit.*).

Treatment Means.

S	...	8·61.	*I*	...	27·8 (modified as above).
C	...	30·00.	*D*	...	10·5.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	29 (31 less 2 for the calculated plots).			
Squares	1	131·22		
Rows	6	55·48		
Columns	6	60·82		
Treatments	3	1009·61	1·90716	100 : 1
Error	13	28·256		

Least significant difference between two treatment means is 5·7%.

Conclusion.—These is no difference between the inoculated plots and the control plots, but both have significantly more infection than the dusted and sterilised plots; the difference between the two latter is not significant.

(f) Leaf Infection at Bukalasa on December 12th.

Expressed as in (e) above.—

C 50·8	D 32·2	I 46·6	S 52·6	S. 57·4	C 67·9	I 74·5	D 60·2
I 58·3	S 58·2	D 49·5	C 53·1	I 67·4	D 55·2	S 62·0	C 55·7
S 42·6	I 81·7	C 59·2	D 48·6	C 57·8	S 66·1	D 64·0	I 77·2 (I 100·0)
D 44·9	C 54·0	S 55·9	I 66·2	D 44·5	I 79·2	C 65·3	S 59·0

Note.—The calculated value I 77·2 has been substituted in the following analysis for the observed value I 100·00 in the above plan.

Treatment Means.

S	...	56·73.	*I*	...	68·89 (modified as above).
C	...	57·98.	*D*	...	49·89.

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"z."*	*"Significance."*
Total	30			
Rows	6	74·77		
Columns	6	35·45		
Squares	1	790·03		
Treatments	3	494·49	1·21653	100 : 1
Error	14	46·499		

Least significant difference between two treatment means is 7·31%.

Conclusion.—The dust treatment has resulted in a lower infection than either the control untreated plots or the inoculated plots; there is no difference between the sterilised plots and the untreated plots at this date; the inoculated plots have more infection than any of the others.

(g) Stem Infection at Serere on October 19th.

Expressed as percentage of number of plants showing leaf infection.

S 2·0	C 15·8	I 27·0	D 2·3	C 10·7	D 2·1	I 17·2	S 2·8
I 22·5	D 2·2	S 10·2	S 4·0	I 3·2	I 9·0	D 2·2	C 12·8
D 6·1	S 9·1	C 4·3	I 18·6	D 4·8	S 2·5	C 13·3	I 20·8
C 8·3	I 34·1	D 24·0	S 6·4	I 25·0	C 14·7	S 19·7	D 23·8

TREATMENT MEANS.

S	...	6·99%.	*I*	...	21·78%.
C	...	10·49%.	*D*	...	8·48%.

ANALYSIS OF VARIANCE.

	Degrees of Freedom.	*Variance.*	*"z."*	*"Significance."*
Total	31			
Rows	6	113·94	0·82772	100 : 1
Columns	6	58·22	—	none
Squares	1	4·73		
Treatments	3	361·68	1·30247	100 : 1
Error	15	26·73		

Least significant difference between two treatment means is 5·50%.

Conclusion.—(*a*) The inoculated plots show a higher proportion of stem infection/leaf infection than any of the other treatments.

(*b*) The bottom row of each square on the above plan shows a higher proportion of stem infection than the other rows; thus indicating that there is an effect of position on this variate, possibly due to soil differences or to the effect of surface wash, which was most severe along these rows.

(h) Stem Infection at Serere on November 9th.

Expressed as above.

TREATMENT MEANS.

S	...	14·675%.	*I*	...	23·938%.
C	...	17·998%.	*D*	...	14·400%.

Analysis of the count made on this date gives the error variance as 42·554; whence the least significant difference between the above treatment means is 6·95%.

Conclusion.—The differences between treatment *I* and *S*, and *I* and *D* respectively remain significant, while that between *I* and *C* is now below the level of significance (P.05).

The differences shown between the bottom row of each square and the other rows on October 19th, still remained significant on November 9th.

(i) Stem Infection at Bukalasa on December 16th.

Expressed as percentage of plants showing leaf infection.—

C 14·6	D 14·7	I 12·0	S 14·4	S 12·2	C 10·7	I 16·4	D 7·4
I 16·0	S 12·2	D 10·4	C 15·2	I 13·6	D 6·7	S 6·5	C 12·8
S 8·6	I 10·1	C 11·6	D 8·3	C 13·3	S 5·3	D 6·6	I 7·7
D 8·0	(C 25·5) C 12·1	S 10·0	I 9·7	D 9·5	I 8·6	C 10·6	S 6·1

NOTE.—The calculated value C 12·1 has been substituted for that of the abnormal plot C 25·5 in the following analysis.

Treatment Means.

S	...	9·41.	*I*	...	11·76.
C	...	12·61.	*D*	...	8·95.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z.*"	"*Significance.*"
Total	30			
Rows	6	14·9095		
Columns	6	7·9362		
Squares	1	35·9128		
Treatments	3	25·3486	0·96850	100 : 1
Error	14	3·6536		

Least significant difference between two treatment means is 2·051.

Conclusion.—There is no difference between the amount of Stem Infection/Leaf Infection in the inoculated and the control plots; both are significantly worse in respect to this variate than either the dusted or the sterilised treatments, between which there is no real difference.

(j) "Infection Days" of Leaf Infection at Serere, up to December 31st.

The following values are obtained by summation of the product No. of infected plants by No. days infected for each plot, and dividing by the final stand, to obtain the average No. of days each plant in the plot was infected.

S 65·9	C 64·1	I 78·8	D 69·4	C 76·6	D 73·3	I 86·9	S 74·4
I 85·1	D 75·5	S 68·3	C 63·7	S 67·3	I 79·6	D 70·2	C 72·9
D 72·6	S 72·1	C 74·1	I 73·2	D 76·0	S 74·3	C 76·8	I 85·8
C 79·7	I 84·5	D 75·1	S 73·9	I 79·3	C 83·8	S 80·1	D 88·3

Treatment Means.

S	...	72·04 days.	*I*	...	81·65 days
C	...	73·96 days.	*D*	...	75·05 days.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z.*"	"*Significance.*"
Total	31			
Rows	6	62·021		
Columns	6	18·451		
Squares	1	151·380		
Treatments	3	139·305	1·02659	100 : 1
Error	15	17·524		

Least significant difference between two treatment means is 4·46 days.

Conclusion.—The inoculated plots have a higher value for "Infection Days" than any of the other treatments; the differences between these latter are not significant.

(k) "Infection Days" of Leaf Infection at Bukalasa, up to December 31st.

Calculated as above for Serere, except that the total was divided by the stand for September 9th, the last stand count made on this experiment.

C 22·5 (C 42·2)	D 17·2	I 23·4	S 17·5	S 21·2	C 33·7	I 56·1	D 18·9
I 22·1	S 19·4	D 14·6	C 24·5	I 28·2	D 16·3	S 21·4	C 23·7 (C 55·8)
S 14·5	I 29·3	C 26·0	D 13·6	C 31·1	S 16·6	D 20·2	I 35·6
D 12·8	C 25·5	S 16·3	I 22·9	D 15·0	I 29·0	C 28·4	S 15·5

Treatment Means.

S	...	17·8 days.	*I*	...	30·8 days.
C	...	26·9 days.	*D*	...	16·1 days.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z.*"	"*Significance.*"
Total	29 (2 plots of *C* treatment have been calculated).			
Rows	6	47·857		
Columns	6	38·651		
Squares	1	246·420		
Treatments	3	404·191	0·66966	20 : 1
Error	13	100·59		

Least significant difference for two treatment means is 10·82 days.

Conclusion.—The difference between treatments *S* and *D* is not significant; both are significantly less than treatment *I* (inoculated plots); also both are significantly less than the untreated plots (*C*); the difference between the inoculated plots and the control plots is not significant.

(l) Combined Analysis of " Infection Days " (Leaf) at both Centres.

	Degrees of Freedom.	*Variance.*	" *z.*"	" *Significance.*"
Total	61 (2 plots at Bukalasa calculated).			
Centres	1	44256·556		100 : 1
Squares	2	198·900		none
Rows and Columns	24	41·745		none
Treatments	3	440·539	1·52057	100 : 1
Treatments × Centres ...	3	111·767	0·83465	100 : 1
Error	28	21·0496		

Least significant difference between two treatment means is 3·32 days.

Treatment Means.

	Serere.	Bukalasa.	Mean.
S ...	72·038	17·80	44·92
C ...	73·963	26·925	50·44
I ...	81·650	30·825	56·24
D ...	75·050	16·075	45·56

Conclusion.—(*a*) The total amount of infection in each treatment as measured by " Infection Days " is greatest in the inoculated plots; followed next by the untreated control plots; the infection in both the dusted and the sterilised plots is less than in the control; the differences between treatments *S* and *D* are not significant.

(*b*) The interaction of treatment and centre is significant, chiefly in that both treatments *S* and *D* have more infection than would be expected at Serere.

(m) " Infection Days " Stem Infection at Serere.

(*i.e.*, No. of plants showing stem infection × No. of days infected (up to December 31st) and divided by final stand).

S 6·2	C 4·6	I 15·9	D 2·0	C 6·8	D 4·4	I 16·7	S 7·2
I 17·4	D 5·7	S 5·5	C 3·2	S 5·2	I 9·5	D 5·0	C 6·8
D 3·1	S 4·5	C 11·3	I 9·7	D 8·7	S 5·3	C 13·3	I 13·1
C 10·3	I 26·2	D 19·5	S 8·7	I 17·1	C 19·7	S 14·6	D 18·7

Treatment Means.

S	...	7·15.	*I*	...	15·70.
C	...	9·50.	*D*	...	8·39.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	" *z.*"	" *Significance.*"
Total	31			
Rows	6	83·3832	1·00412	100 : 1
Columns	6	21·3932		none
Squares	1	10·4653		
Treatments	3	115·5378	1·13808	100 : 1
Error	15	11·8616		

Least significant difference between two treatment means is 3·67 days.

Conclusion.—The inoculated plots show more infection than any of the other treatments, the differences between which are not significant.

(n) " Infection Days " Stem Infection at Bukalasa up to December 31st.

Calculated as above for Serere.

C 2·4 (C 4·2)	D 1·7	I 2·3	S 1·9	S 1·8	C 2·5	I 2·5 (I 5·7)	D 1·8
I 3·4	S 3·0	D 1·6	C 2·1	I 2·3	D 2·2	S 1·5	C 2·9
S 2·0	I 3·2	C 2·6	D 1·5	C 3·1	S 1·8	D 2·3	I 3·1
D 1·8	C 3·2	S 1·9	I 2·6	D 1·8	I 2·5	C 3·4	S 1·9

Treatment Means.

S	...	1·975 days.	*I*	...	2·7375 days.
C	...	2·775 days.	*D*	...	1·8375 days.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	29 (2 plots calculated)			
Squares	1	·00125		none
Rows	6	·14208		none
Columns	6	·25292		none
Treatments	3	1·95375	1·21947	100 : 1
Error	13	·170481		

Least significant differences between two treatment means is 0·446 days.

Conclusion.—The difference between treatments *S* and *D* is not significant; both treatments are significantly better than both *C* and *I;* between the two latter the difference is not significant.

(o) Combined Analysis of Stem "Infection Days" at Both Centres.

Treatment Means.

S	...	4·5625 days	*I*	...	9·2188 days.
C	...	6·1375 days.	*D*	...	5·1125 days.

The least significant difference between these means works out at 1·77 days.

Conclusion.—The inoculated plots have very significantly more infection on this basis than the other treatments; the difference between treatments *S* and *C* falls just short of the level of significance (P. ·05); the other differences are not significant.

(p) Yield of Cotton at Serere. (In lbs. total yield).

S 3·49	C 3·71	I 5·14	D 6·35	C 6·00 (C 8·6)	D 6·58	I 6·16	S 6·01
I 3·80	D 3·97	S 6·07	C 5·65	S 4·79	I 5·22	D 6·50	C 5·06
D 4·94	S 4·30	C 5·31	I 6·80	D 5·60	S 5·15	C 5·65	I 4·75
C 4·43	I 4·66	D 4·87	S 5·54	I 5·05	C 4·97	S 5·42	D 5·04

Treatment Means.

S	...	5·10.	*I*	...	5·07.
C	...	5·10 (modified by calculation of one plot).	*D*	...	5·48

Analysis of these yields indicates that there is no significant difference between these treatment means.

(q) Yield of Cotton at Bukalasa. (In lbs. total yield).

C 6·95	D 15·01	I 9·32	S 12·69	S 12·84	C 10·29	I 9·10	D 12·78
I 3·73	S 11·43	D 9·57	C 14·66	I 10·22	D 9·96	S 8·82	C 10·06
S 7·94	I 10·99	C 8·53	D 10·08	C 8·49	S 10·19	D 7·41	I 4·66
D 7·93	C 13·40	S 13·00	I 9·70	D 8·80	I 4·80	C 8·62	S 11·63

Treatment Means.

S	...	11·07 lbs.	*I*	...	7·82 lbs.
C	...	10·13 lbs.	*D*	...	10·19 lbs.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	31			
Rows	6	6·2344		none
Columns	6	15·4657	0·87516	100 : 1
Squares	1	8·2621		none
Treatments	3	15·4797	0·87561	100 : 1
Error	15	2·6813		

Least significant difference for two treatment means is 1·75 lbs.

Conclusion.—The inoculated plots yielded less than any of the other treatments; the differences between the latter are not significant.

(r) Combined Analysis of Yield at Both Centres.

The differences between treatments are not significant in this analysis.

(s) Correlation Co-efficients.

Total Correlations.	Bukalasa.		Serere.		Both Centres combined.	
	Value.	Significance.	Value.	Significance.	Value.	Significance.
Yield / Stand	+·5109	100 : 1	+·4989	100 : 1	+·4532	100 : 1
Yield / Leaf Infection Days	—·2848	—	—·0728	—	—·2325	10 : 1
Yield / Stem Infection Days	—·3647	20 : 1	—·2572	—	—·3141	50 : 1
Stem Infection / Leaf Infection	+·7833	100 : 1	+·7737	100 : 1	+·7828	100 : 1
Stem Infection / Stand	—·3663	20 : 1	—·3323	10 : 1	—·2798	20 : 1
Leaf Infection / Stand	—·2497	—	—·1449	—	—·1785	—
Partial Correlations.	**Eliminated variate.**					
Yield / Stand ...	Stem Infection	+·4353	50 : 1	+·4536	50 : 1	+·4008	100 : 1
Yield / Stem Infection ...	Stand	—·2217	—	—·1118	—	—·2184	10 : 1
Yield / Leaf Infection ...	Stand	—·1889	—	—·0001	—	—·1729	—
Yield / Stem Infection ...	Leaf Infection	—·2376	—	—·3179	10 : 1	—·2183	10 : 1
Yield / Leaf Infection ...	Stem Infection	+·0002	—	+·2061	—	+·0225	—
Stem Infection / Stand ...	Leaf Infection	—·2783	—	—·3513	20 : 1	—·2288	10 : 1
Leaf Infection / Stand ...	Stem Infection	+·0643	—	+·1878	—	+·0678	—

Conclusions.—A. Serere.

(1) Yield was very significantly correlated with stand.

(2) The correlation with stem infection days was negative, but below the level of significance.

B. Bukalasa.

(1) Yield was very significantly correlated with stand.

(2) Both yield and stand are significantly correlated with stem infection days, the correlation in both cases being negative.

C. Both Centres Combined.

Yield is positively correlated with plant population (stand) and negatively with Blackarm infection, the latter being measured as "stem infection days." Stand is negatively correlated with stem infection.

The only significant partial correlation is that of yield and stand; with stem infection eliminated. The coefficients for yield and stem infection (·2183 and ·2184) are below the level of significance (P. ·05 is ·2500).

Additional Co-efficients for Bukalasa.

	Value.	Significance.		Value.	Significance.
Yield / %Helopeltis attack ...	—·6370	100 : 1	%Helopeltis attack / Leaf infection days ...	—·2266	—
Yield / %Lygus attack ...	+·2345	—	%Helopeltis attack / Stem infection day ...	+·3750	20 : 1
%Helopeltis attack / Lygus attack ...	—·3279	10 : 1			

From the above it is evident that *Helopeltis* has a great influence on yield at this centre. The significance of the correlation between *Helopeltis* attack and stem infection days (*i.e.*, Blackarm disease) may be only apparent, as at some stages there is considerable difficulty in distinguishing between the damage on the plant due to these factors.

Lygus attack appears to have no significant influence on yield; in this experiment this insect appeared to avoid plants attacked by *Helopeltis*. This is conceivable in that the latter insect has such a severe effect upon the development of the plant that the latter may not be sufficiently attractive to *Lygus*.

(t) Helopeltis Attack on November 21st at Bukalasa.

Expressed as percentage of plants in plot showing attack.

C 62·7	D 44·6	I 35·7	S 26·7	S 32·6	C 36·0	I 41·4	D 47·2
I 76·6	S 48·6	D 43·1	C 31·6	I 34·2	D 43·1	S 28·1	C 51·2
S 55·5	I 50·2	C 37·9	D 34·7	(C 50·4)	S 45·7	D 58·9	I 71·4
D 38·3	C 29·6	S 38·3	I 44·8	D 38·1	I 58·1	C 55·4	S 54·2

The plot C 50·4 was omitted from the actual count made on this date, and the value has been calculated.

Treatment Means.

S	...	41·2.	*I*	...	51·6.
C	...	44·4.	*D*	...	43·5.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	30			
Squares	1	69·3253		
Rows	6	202·1537	0·55834	20 : 1
Columns	6	315·1287	0·78029	100 : 1
Treatments	3	159·5370	0·44003	none
Error	14	66·1764		

Conclusion.—There is no difference in the intensity of the attack of this insect between the four treatments of this experiment; there is, however a significant positional effect. This may be due to differences in soil characters; the end columns of the experiment show the heaviest attack, and those in the middle the least.

(u) Lygus Attack on December 2nd at Bukalasa.

Expressed as percentage of plants attacked in each plot.

C 3·2	D 5·5	I 12·5	S 9·4	S 16·2	C 13·7	I 9·3	D 5·9
I 10·4	S 9·9	D 9·7	C 13·4	I 17·7	D 10·1	S 8·8	C 6·6
S 5·6	I 15·4	C 8·6	D 9·9	C 9·7	S 12·5	D 5·7	I 7·6
D 3·1	C 9·4	S 4·2	I 9·3	D 3·7	I 5·0	S 4·6	C 4·2

Treatment Means.

S	...	8·9.	*I*	...	10·9.
C	...	8·6.	*D*	...	6·7.

Analysis of Variance.

	Degrees of Freedom.	*Variance.*	"*z*."	"*Significance.*"
Total	31			
Squares	1	0·1013		
Rows	6	27·7681	0·79358	100 : 1
Columns	6	24·4114	0·72917	100 : 1
Treatments	3	23·647	0·71326	20 : 1
Error	15	5·6787		

Least significant difference between treatment means is 2·54.

Conclusion.—The attack of Lygus is influenced by soil factors, or at least by the position of the plot in the experiment; rows and columns being both very significant in the above analysis.

To a smaller extent the attack of this insect is also influenced by the treatments used in this experiment, the plots sown with the dusted seed showing significantly less attack than the inoculated plots.

(v) Percentage Deaths During the Season at Serere.

There were no significant differences between treatments.

(w) Spreading of Infection, October 4—19, at Serere.

This was the period of most rapid spread of the disease, but the counts made during this period show no significant differences between treatments when analysed on any of the following bases:—

(*a*) No. of new infections per plot.
(*b*) New infections/stand.
(*c*) New infections/infection on October 4th.

EXPERIMENT II.

Objects.—The study of the spread of Angular Leaf Spot in relation to climatic conditions. The correlation, if any, between the duration of infection on the plant and its yield. The influence of various types of infection by *B. malvacearum* on yield. The possible influence of certain other factors, including some insect pests, on yield.

Lay-out.—The experiment consisted of a square of 55 by 55 holes spaced 3 ft. by 3 ft. In the centre of the plot a square of 3 by 3 holes was sown with seed soaked in a culture of *B. malvacearum*, the rest of the plot being sown with seed sterilised as far as possible by delinting with sulphuric acid followed by treatment under vacuo with a solution of mercuric chloride.

Observations.—These were made during the early part of the growing season, three times a week, later, after germination and the shedding of the cotyledons were completed, twice a week; and finally as the progress of the disease became somewhat retarded only once a week. At each observation a complete plan of the plot was prepared, showing each plant in the plot (in the earlier plans holes were indicated instead of individual plants) together with the type of infection on it. The following types of infection were marked separately on each plan:—

Infection on the cotyledons (primary infection arising from the seed).
Infection on the hypocotyl (primary infection arising from the seed).
Infection on the leaves (secondary by spread from other plants).
Infection on the main stem.
Infection on the main branches.

In addition, the following observations were made at Serere at the time the plants were uprooted at the end of the season:

Number of bolls on each plant, used as an index of yield.

Absence of monopodia at the base of the plant.

Development of only one monopodium, instead of the usual two to four.

Whether the plant had been topped or not by hail or *Earias*.

Number of sympodia affected with *B. malvacearum*.

Number of monopodia similarly infected.

For the boll count only those bolls over half developed were included, including all those from which cotton had been picked.

At Bukalasa, the same observations on disease were made during the season, with two plans including attack on individual plants by either *Lygus* or *Helopeltis*. Yield was estimated as above by counting the bolls produced on each plant.

History—Serere.—The experiment was sown on August 17th, rather late in the season for this part of Uganda, on freshly opened land separated from all other cultivation by undisturbed grassland at least 25 yards wide, to act as a screen to prevent the spread of disease into the plot from other cotton in the vicinity. The plot was also surrounded by a trench, to prevent wash from other plots entering the experiment. Unfortunately owing to the late sowing the development of the plants was distinctly below normal; they were also retarded in their growth by the fact that the land had not been opened for cultivation prior to the sowing of the cotton, this effect of freshly opened land on the cotton crop being particularly noticeable in this district. The plants received a further check in the form of a very severe hail storm on September 13th. The plants were uprooted on February 17th.

Bukalasa.—The experiment was sown on 20th July, on a patch of land freshly opened up from Elephant Grass, and remained surrounded by a belt of this grass until the end of the season. The final observations were made in mid-March and the plants uprooted.

RESULTS.

(a) Spread of Leaf Infection.

The following figures show the progress of this form of the disease through the plot week by week from the first reliable observation; the last column represents the average number of bolls per plant on the plants infected during that week.

SERERE.

Week ending.	Total No. infected plants.	New infections.	% Increase during week.	Yield per plant.
September 24th	5			
October 1st	13	8	160	
,, 8th	27	14	108	
,, 15th	57	30	111	
,, 22nd	117	58	102	8·28
,, 29th	244	127	109	7·84
November 5th	394	150	61	8·87
,, 12th	536	142	36	10·37
,, 19th	609	73	14	9·40
,, 26th	785	176	29	9·79
December 3rd	1,043	259	33	9·10
,, 10th	1,376	333	32	10·22
,, 17th	1,511	135	10	9·83
,, 24th	1,674	163	11	9·74
January 3rd	2,679	905	27	8·82

NOTE.—On January 3rd all plants in the plots showed infection on the leaves. Many of the plants shown above as becoming infected during the period December 17th to January 3rd, were very slow growing and under developed; had they been growing in a more normal manner it is probable that infection would have taken place earlier, especially as many were in close proximity to infected plants.

Ignoring these, the general trend of the last column indicates that early infection has a greater effect in reducing the yield than late infection.

BUKALASA.

Period ending.	Total No. infected plants.	New infections.	% Daily increase during period.	Yield per plant.
September 1st	20	—	—	—
,, 8th	16	—	—	—
,, 15th	35	—	—	—
,, 22nd	16	—	—	—
,, 27th	22	—	—	—
October 4th	15	—	—	—
,, 11th	21	—	—	—
,, 18th	14	—	—	—
,, 25th	15	—	—	—
November 1st	67	52	75·3	17·5
,, 8th	138	71	15·1	17·3
,, 17th	293	155	12·4	19·9
,, 24th	405	112	5·4	17·7
December 8th	878	473	8·4	17·4
,, 20th	1,324	446	3·6	18·3
January 3rd	1,634	310	1·6	17·1
,, 17th	1,968	332	1·4	17·4

From the above table it is evident that at this centre the effect of the leaf form of the disease upon yield is very small if any; as shown in the last column there is no evidence of the effect being related to length of infection period.

The dates given in the first column were selected as those on which the most reliable observations were made, as indicated by comparison of successive plans. In consequence of the varying periods between these selected dates, the column for percentage increase of the disease has been calculated on an average daily rate, assuming that during each period the rate was constant.

(b) Direction of Spread.

Serere.—The direction of spread was calculated as the resultant of the individual spread from plant to plant, obtained by comparison of successive observation plans of the plot through the season, up to December 17th. This resultant direction is closely comparable with direction of the prevailing wind. Owing to the absence of a wind direction recording instrument, more detailed comparison was not possible.

The result is in accordance with expectation and with experience in other countries; but where severe surface wash occurs this modifies the direction of spread of the disease and may obscure completely the effect of spread down wind, as was pointed out in the account of the experiment carried out at Kampala in 1931-32 (*see* Report of Mycologist, in Annual Report, Dep. Agric. Uganda for 1931. *Also* Ann. App. Biol. 1933, Hansford, Hosking, Stoughton & Yates, in press).

Bukalasa.—The average direction of spread was calculated as above; the resultant direction was parallel to the prevailing day wind, while at right angles to the direction of the prevailing night wind. It was also slightly down the slope of the plot, but not parallel with the maximum slope. There was very little sign of wash in this plot, so that the directional

effect of surface wash down the slope in spreading the disease was very small. It would appear from the result obtained that the directional effect of day storms is greater than that of night storms taken through the season; this is probably correlated with the relative frequency of storms at different hours, upon which there are no data available for this season.

(c) Blackarm Infection—Serere.

Week ending.	No. plants newly infected.	No. plants died afterwards.	Yield per plant.
September 24th	1	1	nil
October 1st	—	—	—
,, 8th	—	—	—
,, 15th	11	4	5·36
,, 22nd	11	1	4·18
,, 29th	10	1	4·80
November 5th	11	0	7·00
,, 12th	8	0	4·50
,, 19th	7	0	3·43
,, 26th	1	0	4·00
December 3rd	2	1	2·00
January 3rd	69	1	8·13

(d) Correlation of Spread of Angular Leaf Spot with Climatic Factors.

The following climatic factors were considered in respect to their possible influence on spread of the disease:—

Rainfall. Air temperature. Air humidity.
Sunshine. Soil temperature.

Comparison of the curves for these factors indicates that all are closely related to that of rainfall, and consequently this was selected as being representative of the others.

Serere.—In Fig. I the dotted line shows the relative percentage spread of the disease in the plot week by week. The other curve given represents smoothed 7 day means of the daily rainfall, and has been retarded three weeks on the chart to emphasise the close similarity with the disease curve.

(e) Effect of Various Factors on Yield—Serere.

During the course of the observational work on this experiment it became obvious that other factors and types of damage to the plant were exerting a considerable influence upon the crop producing capacity of the plant. At the time the plants were uprooted the following characters were noted for each individual plant:—

A. Infection of Blackarm at the base of the main stem.

C. Infection on the basal monopodia.

D. Infection on the sympodia.

E. Complete absence of basal monopodia, whether due to disease, other forms of damage or merely non-development.

F. Topping of the main stem by hail or by *Earias*. In future work it is hoped to be able to separate this factor into two parts according to whether topping took place early in the development of the plant or at a later stage, *i.e.*, below 12 ins. from the ground or above that level.

G. Development of only a single monopodium at the base of the plant.

The following table contains the statistics extracted from the observation plans of the experiment, dealing with the above factors and their combinations:—

Factor.	No. of plants.	Mean yield.	S. Error of mean.	% of mean for healthy plants.
A	17	10·18	1·51	70·0
C	10	15·50	1·83	106·5
D	765	10·50	0·21	72·2
E	102	5·25	0·32	37·0
F	143	10·81	0·54	74·3
G	128	8·68	0·43	59·7
AC	4	15·00	5·25	103·1
AD	38	5·92	0·67	40·7
AE	15	2·87	0·57	19·7
AF	7	4·71	2·58	32·4
AG	35	6·83	0·61	46·9
CD	14	9·57	1·20	65·8
CF	5	6·20	1·39	42·6
CG	5	6·40	1·36	44·0
DE	200	5·88	0·24	40·4
DF	86	9·28	0·56	63·8
DG	487	7·69	0·20	52·9
EF	3	5·67	2·40	39·0
FG	8	7·75	1·55	53·3
ADE	11	4·27	0·62	29·3
ADF	4	5·50	0·87	37·8
ADG	27	6·89	0·62	47·4
ADF	3	8·67	4·18	59·6
ADG	3	8·33	0·88	57·2
DFG	5	6·40	0·68	44·0
DEF	2	5·00	1·98	34·4
Healthy	316	14·55	0·41	100·0

Notes.—1. The plants included as " Healthy " are those in the experiment which were affected by none of the above factors; all were infected on their leaves with *B. malvacearum*.

2. The plants included under factor *A* in the above table do not included the nine plants which died during the course of the experiment as a result of their having been attacked by Blackarm disease at the base of their stem, including these the values of factor *A* would be:—

A	...	26	...	6·65	...	1·37	...	45·7

The frequency distribution curves for factors *D*, *E*, *F* and *G* are given in Figs. III and IV, and also that of the " healthy " plants for comparison.

In the following table the results given above are set out and compared with values calculated on the assumption that the effect of each separate factor is independent of that of the others when two or more factors affect the same plant.

In general it appears that factors *A*, *C*, *D*, *F* and *G* are more or less independent in their action upon the plant, while factor *E* (total absence of basal monopodia) has such a large effect upon the plant that in combination with the other factors the effect of the latter is modified.

Healthy 100·0	C	D	A	F	G	E
C	106·5	65·8 (78·8)	103·1 (76·5)	42·6 (80·8)	44·0 (66·2)	—
	D	72·2	40·7 (42·2)	63·8 (46·5)	52·9 (31·9)	40·4 (9·2)
		A	70·0	32·4 (44·3)	46·9 (29·7)	19·7 (7·0)
			F	74·3	53·3 (24·0)	39·0 (3·0)
				G	59·7	—
					E	37·0

(f) Effect of Various Factors on Yield—Bukalasa.

Factor.	No. of plants.	Mean yield.	S. Error of mean.	% of mean of healthy plants.
Healthy plants	881	17·67	0·262	100·0
Angular leaf spot only	1,398	17·66	0·191	100·0
Black Arm on main stem	61	16·48	0·69	93·3
Black Arm on branches	82	19·11	0·836	108·1
Lygus slight attack on 3rd November ...	153	16·57	0·566	93·8
Lygus severe attack on 3rd November ...	17	12·35	1·09	69·9
Helopeltis slight attack on 3rd November ...	20	14·15	1·405	80·1
Helopeltis severe attack on 3rd November ...	14	13·07	1·47	74·0
Helopeltis and Angular leaf spot	20	16·65	1·50	94·3
All plants affected with *Helopeltis* ...	54	14·80	0·863	83·8
Lygus and Angular leaf spot	392	17·44	0·371	98·7

The plants shown as infected with Lygus and Helopeltis above were extracted from the observation plan dated November 3rd; unfortunately no record of such plants is available after this date, with the result that some of the plants recorded above as " healthy " were probably infested with these insects. This would result in the mean given above being below the mean for truly healthy plants, with the result that the differences in the last two columns between the mean for the " healthy " plants and those for plants affected with one of the above factors may be taken as minimum differences.

From the above table it appears that of the factors given Angular Leaf Spot has no effect upon crop production. Stem infection by *B. malvacearum* reduces the crop produced, but has little or no effect when limited to the branches. Both *Lygus* and *Helopeltis* are important factors in crop production.

Fig. V shows the frequency distribution for the healthy plants of this experiment, including those given in the above table as showing Angular Leaf Spot only.

Figure I. DISEASE AND RAINFALL AT SERERE.

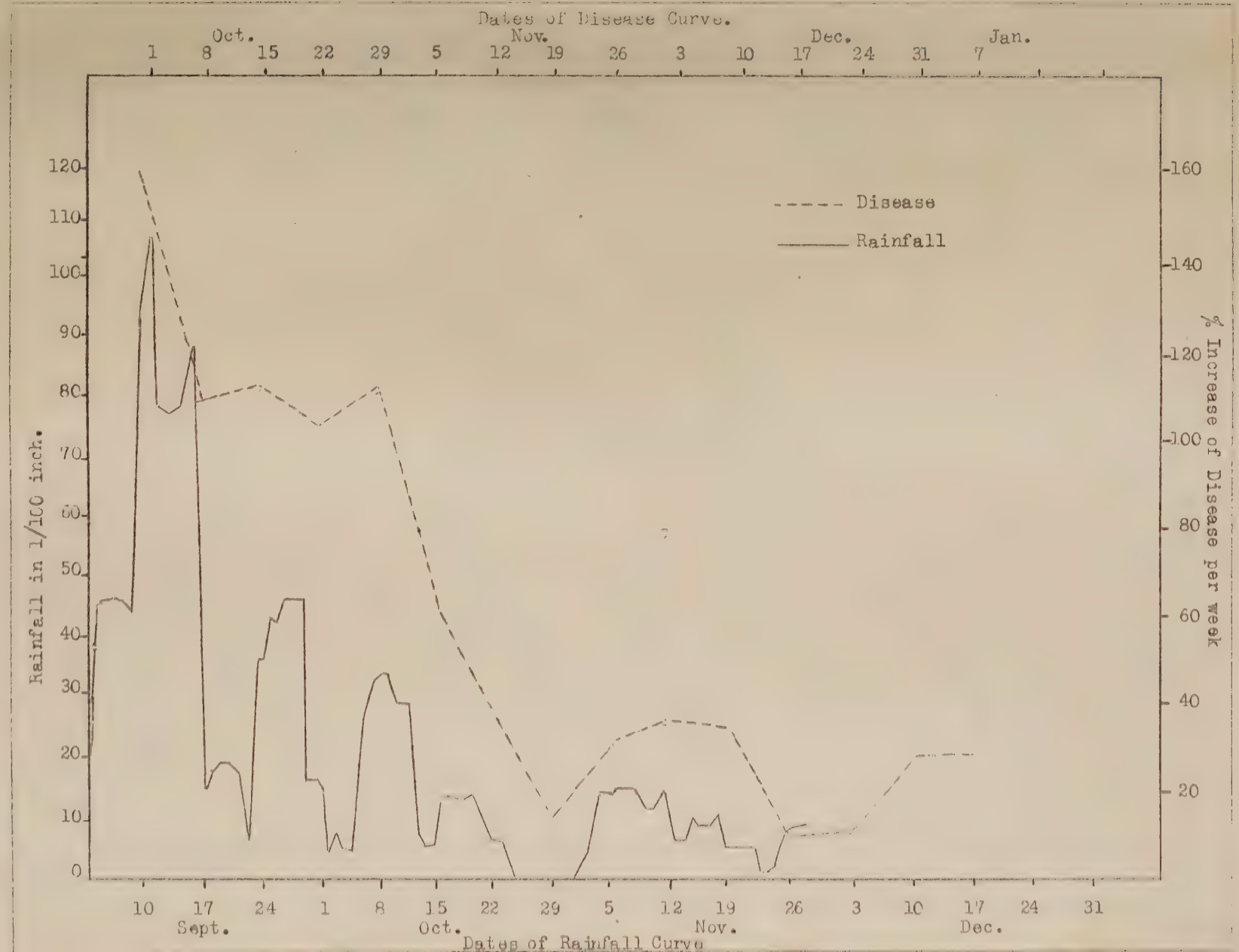

Dates of Disease Curve.
Oct.
Nov.
Dec.
Jan.
1 8 15 22 29 5 12 19 26 3 10 17 24 31 7
Disease
Rainfall
Rainfall in 1/100 inch.
% Increase of Disease per week
0 10 20 30 40 50 60 70 80 90 100 110 120
20 40 60 80 100 120 140 160
10 17 24 1 8 15 22 29 5 12 19 26 3 10 17 24 31
Sept.
Oct.
Nov.
Dec.
Dates of Rainfall Curve

Figure II. DISEASE AND RAINFALL AT BUKALASA.

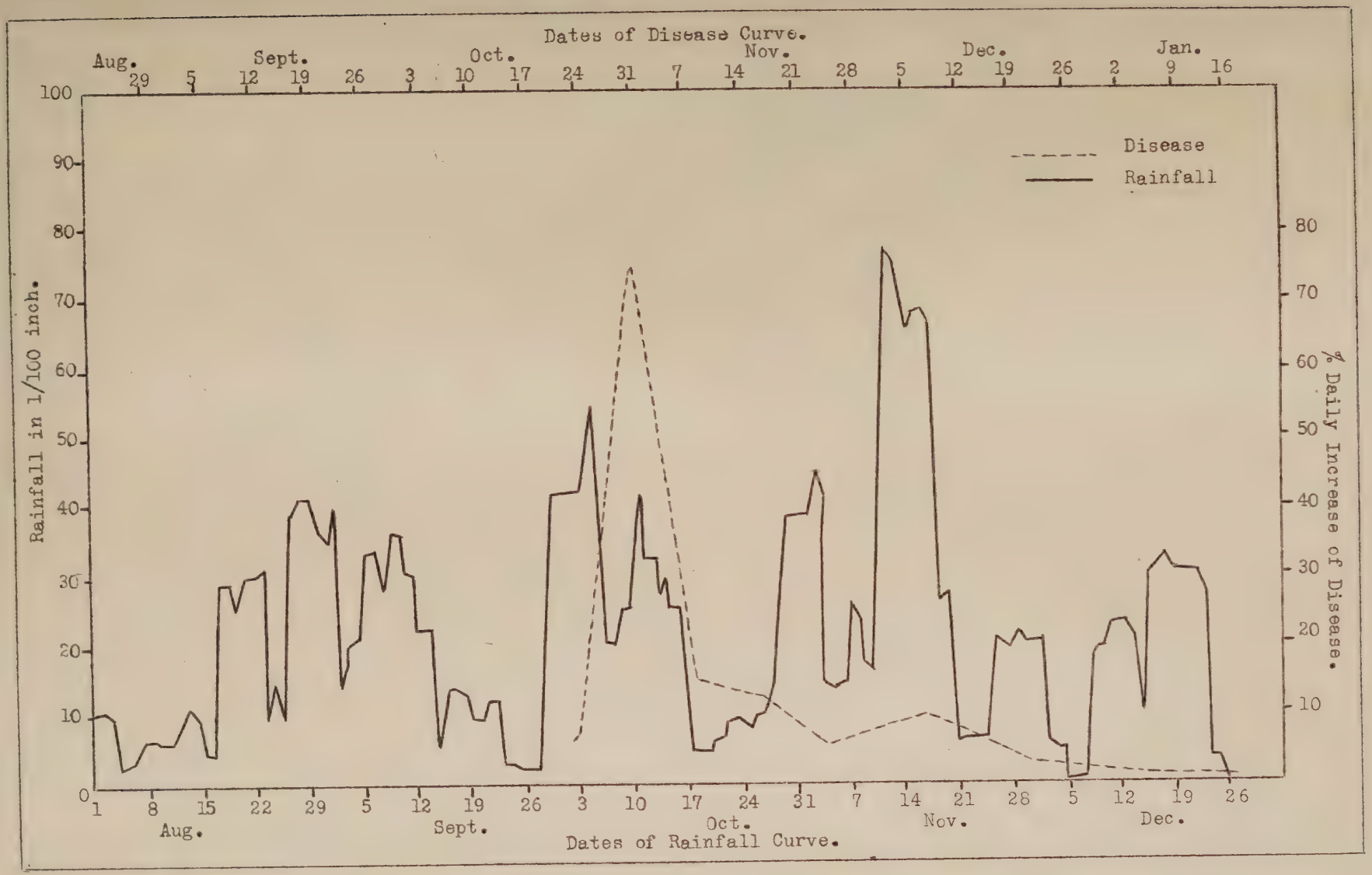

Dates of Disease Curve.
Aug. Sept. Oct. Nov. Dec. Jan.
29 5 12 19 26 3 10 17 24 31 7 14 21 28 5 12 19 26 2 9 16
Disease
Rainfall
Rainfall in 1/100 inch.
% Daily Increase of Disease.
0 10 20 30 40 50 60 70 80 90 100
1 8 15 22 29 5 12 19 26 3 10 17 24 31 7 14 21 28 5 12 19 26
Aug. Sept. Oct. Nov. Dec.
Dates of Rainfall Curve.

Figure III. EFFECT OF LOSS OF MONOPODIA.

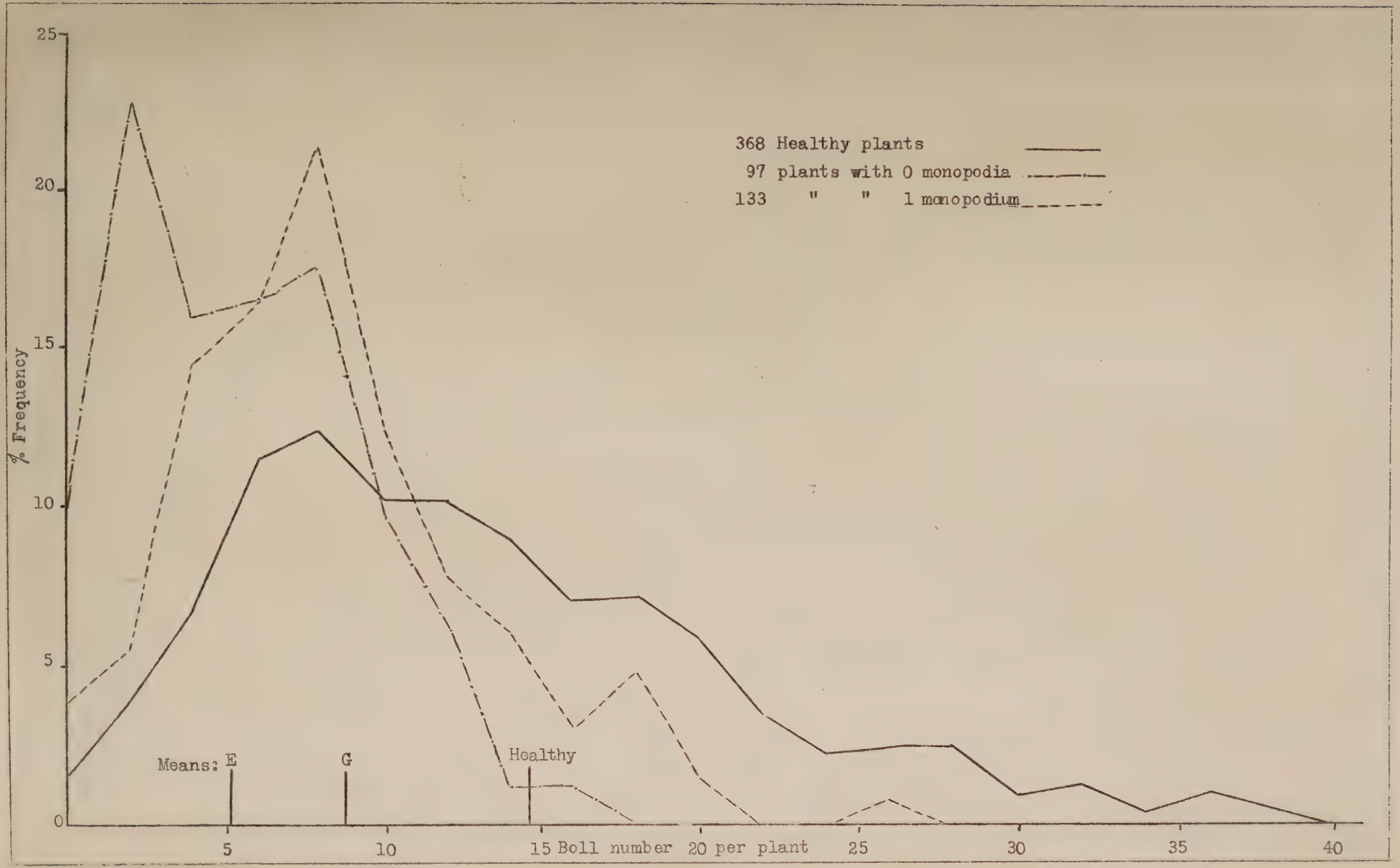


Figure IV.

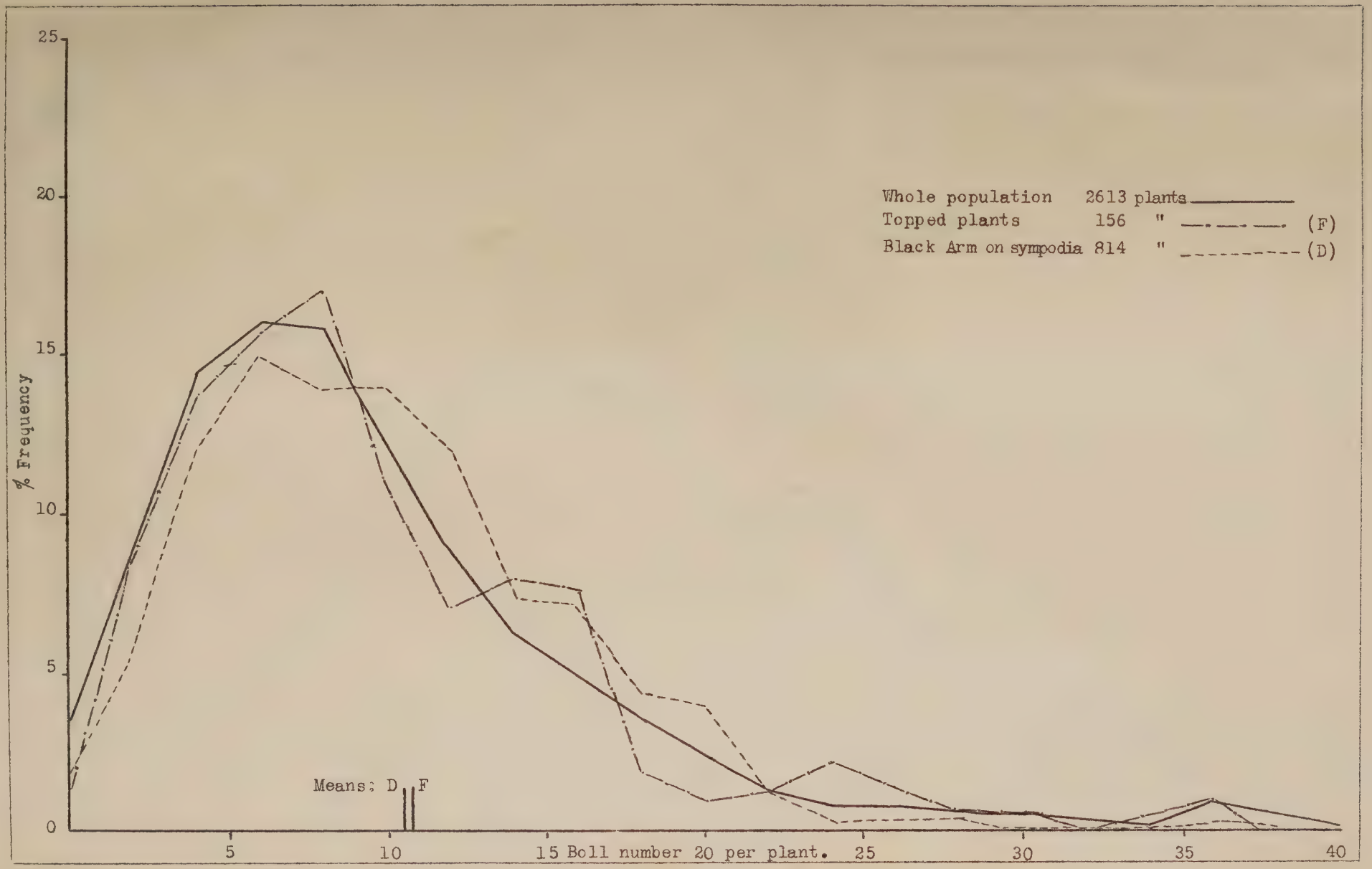
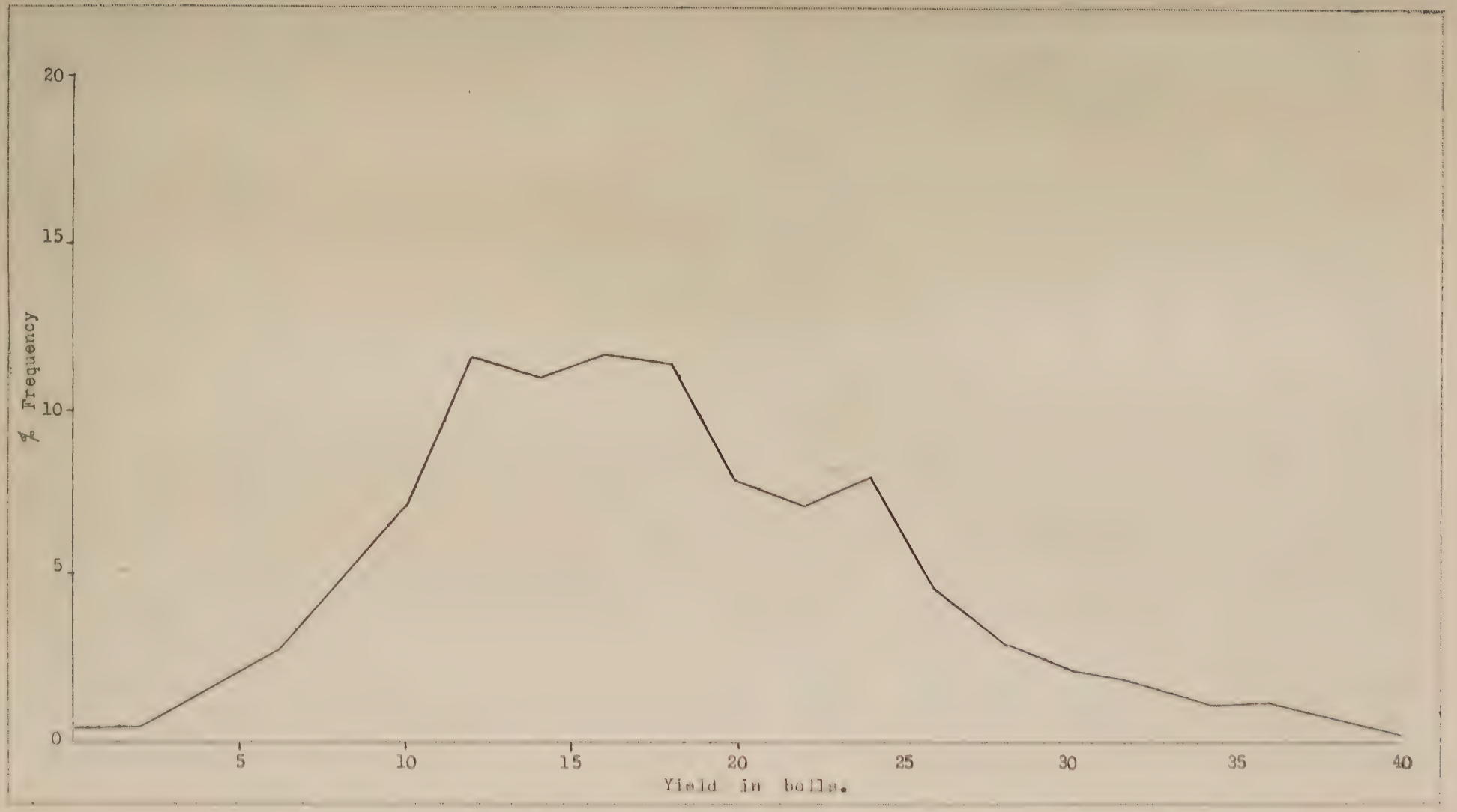

25
20
15
10
5
0
% Frequency
Whole population 2613 plants
Topped plants 156 " (F)
Black Arm on sympodia 814 " (D)
Means: D F
5
10
15 Boll number 20 per plant.
25
30
35
40

Figure V. FREQUENCY DISTRIBUTION OF YIELD OF 2279 HEALTHY PLANTS AT BUKALASA.



EXPERIMENT III.

Object.—The comparison of the effect on yield of various types of infection by Blackarm disease and some forms of injury to the plant.

Lay-out.—The experiment consisted of three blocks of twenty rows of twenty-four plants each, planted 3 ft. by 3 ft. Originally it was intended to utilise whole rows of plants for each form of treatment, but owing to very poor germination and to damage due to hail, the plan was modified to use single plants scattered at random through each block.

The following treatments were carried out:—

C. Inoculation with *B malvacearum* on the basal monopodia when these had reached a length of six inches.

E. Cutting off the monopodia at similar stage.

In addition a number of plants were selected as showing natural infection on the main stem.

Observations.—A detailed survey of the experiment was made on December 16th, four months after planting, of all Blackarm lesions on each plant, and the result plotted on a plan. A similar survey was made at the time of uprooting the plants, together with the crop production, counted as the number of bolls more than half size, formed on each plant.

Results.—The average crop production from plants which showed no Blackarm and had developed in a more or less normal manner was computed for each of the three sub-plots, with the result that for two of the three sub-plots the mean crop production showed no significant difference. In consequence in computing the average production for plants affected by one or more of the factors set out below these two plots were combined as one. The third plot showed a much lower yield in each class of plant, obviously due to the effect of poorer soil hampering the normal development of the plants, and the results from this sub-plot have been omitted from the tables below, as this soil effect was so large as to modify the effects due to other factors.

The factors *A*, *C*, *D*, *E*, *F* and *G* below are the same as those described under the same notation in table above.

B. Infection on the main stem at a higher level than those included under *A*.

H. Development of monopodia at a higher level than is usual on the plants of S.G. 29, the variety used in all these experiments; often to compensate for the destruction of monopodia at the base of the plant.

Factor.	Plant Number.	Mean Yield.	Standard Error of Mean.	% of Healthy. Mean.
A	4	20·00	6·35	81·6
C	6	15·67	2·75	64·0
D	47	20·72	1·00	84·6
E	16	9·00	0·89	36·7
F	53	21·00	0·93	85·7
G	19	18·68	1·36	76·2
AB	6	8·67	0·55	35·4
AC	13	18·77	1·91	76·6
AD	36	15·94	1·01	65·1
AE	42	7·21	0·53	29·4
AF	44	16·11	1·22	65·8
AG	33	12·30	1·02	50·2
AH	10	14·80	1·41	60·4
CD	27	18·00	1·72	73·5
CF	14	22·64	2·10	92·4
CG	12	15·50	2·49	63·3
DE	41	7·95	0·45	32·4
DF	31	18·29	1·08	74·7
DG	62	15·71	0·84	64·1
DH	12	18·17	1·83	74·2
EF	11	9·55	1·71	39·0
EH	22	22·68	2·01	92·7
FG	42	16·33	0·94	66·7
FH	14	20·29	2·27	82·8
GH	7	15·00	2·02	61·2
Healthy	50	24·50	1·15	100·0

Comparison of the means of A and AB above indicated that there is no real difference between the effect of these two factors; the combined groups have the following statistics:—

A and AB ... 10 ... 13·20 ... 3·16 ... 53·8.

In the following table the figures in brackets have been calculated on the assumption that where two or more factors affect the same the combined effect in reduction of crop is the sum of the effects due to each separate factor. The factor C was an exception to this as the value of C when acting independently is much too low as compared with its value taken in combinations with other factors. The figures calculated for C and its combinations are from average of its effect when combined with F, A, D and G. With regard to the factor H, its effect in combination with E, is to replace the monopodia cut off in factor E, and the resultant crop is very little short of normal. It would be expected that the value of H would be much greater in combination with factor E than in other combinations, which is the case in this experiment.

The other values for H in brackets in the table were calculated from an average of its effect when in combination with F, D, A and G.

	C	F	D	A	G	E	H
C	64·0 (98·1)	92·4 (82·8)	73·5 (82·7)	76·6 (79·7)	63·3 (74·5)	—	—
	F	85·7	74·7 (71·3)	65·8 (67·3)	66·7 (61·9)	39·0 (22·4)	82·8 (73·3)
		D	84·6	65·1 (66·2)	64·1 (60·8)	32·4 (21·3)	74·2 (72·2)
			A	81·6	50·2 (57·8)	29·4 (18·3)	60·4 (69·4)
				G	76·2	—	61·2 (63·8)
					E	36·7	92·7
						(H)	(87·6)

FDA	...	57·1	...	(51·9)	FGH	...	53·1	... (39·5)
DAG	...	45·7	...	(42·4)	ADE	...	27·3	... (2·9)
FDG	...	40·8	...	(46·5)	AEF	...	57·8	... (4·0)
AFG	...	47·3	...	(43·5,	AEH	...	82·4	... (74·3)
ACD	...	70·1	...	(64·3)	DEH	...	97·6	... (77·3)
ACF	...	51·7	...	(65·4)	FEH	...	107·5	.. (78·4)
ACH	...	69·4	...	(67·3)	AFH	..	108·9	... (54·9)
AGH	...	49·0	...	(45·4)	CDF	...	87·1	... (68·4)
CDG	...	61·2	...	(58·9)	CGF	...	70·7	... (60·0)
DGH	...	49·0	...	(48·4)				

On the whole it is evident that the greatest divergence between the observed and calculated values for both two and three factors in combination is in those cases including the factor E. The effect of this factor on the plant is so great as to modify the effect of any other additional factors.

The results obtained indicate that in the case of the cotton variety S.G. 29, with which these experiments are concerned, any interference with its production of monopodia, of which there are usually two or three per plant, has a large effect upon its capacity for production of crop. Even the reduction of these to one per plant causes an average loss of a quarter of the crop, while complete absence of the monopodia reduces the crop to roughly one-third. In comparison with this effect the result of Blackarm infection, even on the main stem is comparatively small, provided the plants are able to show reasonable recovery from the attack, as occurred in the present experiment.

GENERAL SUMMARY OF RESULTS, AND DISCUSSION.

(1) *Effect of Seed Treatment Upon Yield of Cotton and Upon Disease.*—At both centres the effect of disinfection of the seed before planting is to reduce the amount of disease in the crop, chiefly by retarding the spread during the early part of the season. In these experiments the numerical value of "Stem Infection Days" and "Leaf Infection Days" have been used as an index of the amount of infection present in the crop. In the light of the results obtained this seems to be the most suitable expression of this variate.

At Bukalasa the yield of the heavily infected plots sown with inoculated seed was significantly below that of all other treatments. The differences in yield between the disinfected seed and the untreated control were not significant. At Serere there were no significant differences between the treatments as yield. The most likely explanation of the small differences observed in these experiments between the various treatments is that under the conditions of these experiments the differences in amount of disease which were evident at the commencement of the experiments became obscured sooner or later by spread of the disease from plot to plot. This secondary spread of the disease occurred much earlier at Serere than at Bukalasa, with corresponding diminution of the differences in yield due to treatment. These experiments do not rule out the possibility that were all the seed used thoroughly disinfected a considerable gain in crop would be experienced, as in that case the danger of early spread of the disease would be minimised.

For the 1933-34 season it is hoped to further control the spread of the disease from plot to plot by more efficient barriers, when the differences in yield due to treatment should be more apparent.

(2) *Effect of Disease upon Yield.*—The stem form of Blackarm disease is significant in its effect upon yield in these experiments. The effect of disease upon stand also appears to be significant. On the other hand the leaf form of the disease has had no effect upon yield,

which is borne out by our experience in Uganda. The leaf form of the disease occurs here every year, on almost every cotton plant in the Protectorate, but no effect upon yield has been noticed, except in those years when the stem form becomes widespread.

The insect *Helopeltis* has a very marked effect upon yield of cotton at Bukalasa. At Serere its occurrence was comparatively rare during the past season and no statistics are available.

(3) *Effect of Treatment upon Stand and Germination.*—The effect of dusting the seed with the compound used in these experiments (Dupont " Granosan ") was to increase the rate of germination, the percentage of germination and the resistance of the plants to adverse conditions throughout the season, as shown at Serere in the counts of the final stand at the end of the season, which were significantly in favour of this treatment, the difference being about one-eighth of the stand of the control plots.

Inoculation of the seed with *B. malvacearum* reduces the stand, presumably by the death of the young seedlings due to early and heavy infection.

(4) *Effect of Climate on Spread of Disease.*—The rate of spread of the disease is closely correlated with rainfall, the factor which appears to have the greatest effect upon the plant. Other climatic factors are so closely correlated with rainfall that their individual influence upon the spread of the disease cannot be determined.

The direction of spread of the disease at Serere is roughly down the prevailing wind, in those situations where surface rain wash can be prevented. The effect of the latter is to modify or even to completely obscure the directional effect of rainstorms.

(5) *Effect of Various Factors upon Yield of the Cotton Plant.*—In these experiments an analysis of yield was made in connection with several types of infection by *B. malvacearum* and other factors causing damage to the plant.

Of those used in this analysis, by far the most important in its effect upon yield was the extent to which the basal monopodia (" vegetative branches ") were developed. Absence of these leads to a very meagre crop in the case of the variety of cotton used in these experiments—S.G. 29. The absence of these monopodia may be due to several causes, such as hail damage in the early part of the season, or to attack by Blackarm at a similar stage. In view of the latter it would appear that early attack by this organism upon the crop is likely to lead to severe damage, if it occurs in such a way as to hinder the normal development of the monopodia. For experiments for next season this same variety of cotton will be compared with a selection from U. 4, which is a type not so dependent upon its monopodia for crop production.

Whereas complete loss of the monopodia results in about one third of the normal crop being produced, other factors and types of damage are much less important in their effect upon yield. The following figures show the approximate loss of crop due to the factors used in the analysis of yield in these experiments:—

Complete loss of monopodia	60%	
Reduction to a single monopodium	25%	
Blackarm, early infection on main stem	25%	(*See* note).
Blackarm, later infection on monopodia, after these have developed normally	nil.	
Blackarm, infection on sympodia	20%	(*See* note).
Topping of main stem	20%	(*See* note).

In general, the minor factors act upon the plant independently, that is, the loss of crop from a plant attacked by more than one of these, is the sum of the losses due to the separate factors.

Notes.—The damage given above as due to early Blackarm infection on the main stem, does not include that on any plant which dies as the result of such infection; in practice a considerable proportion of such plants die.

Infection on the sympodia is difficult to estimate, and will depend largly upon climatic conditions in the later part of the season as to the proportion of sympodia on the plant attacked.

Topping of the main stem is very definitely harmful at early stages in the crop, but later on it is doubtful whether any harm results from topping at say 18 ins. high high or more. Unfortunately the results obtained from these experiments do not differentiate between these two possible effects.

C. G. HANSFORD,

Mycologist.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST, 1932.

GENERAL.

The Agricultural Chemist attended a Conference of East African Soil Chemists at Amani, from May 21st to 26th, the proceedings of which have already been published.

The conference was particularly helpful in making contacts; an agreement was reached regarding uniformity of survey procedure and of analytical methods.

I was absent on leave from July 9th until the end of the year during which time the work of the section was carried out under the direction of Dr. G. Griffith, Assistant Agricultural Chemist.

LABORATORY.

The following is a summary of the work carried out in the laboratory during the year:—

Soils.

Mechanical analyisis.	128.	Nitrogen	284.
Clay fraction analysis	45.	Moisture % at point of stickiness	430.
Carbon and organic matter ...	125.	Reaction	436.

Miscellaneous.

Essential oils	10.	Boiler sludge and scale	3.
Waters	15.	Coffee moisture content	60.
Feritilisers	5.	Annatto extractions	2.
Limestones	4.		

SOILS.

The general routine examination of soils, *i.e.*, mechanical analysis, moisture-content at the point of stickiness, Comber test and Nitrogen determination have been continued. The determination of carbon by wet combustion methods was discontinued at the end of May in accord with the decision of the Amani Soil Chemists' Conference that carbon determination should be carried out by the Worsley and Nutman dry combustion method. The necessary apparatus was ordered but had not arrived at the end of the year.

A series of deep pits at Bukalasa along a traverse down a fairly steep slope has revealed the fact that soils similar to the three types discussed in last year's report may be found within a few hundred yards of each other in the rolling type of country usually found in Buganda. The upper pits gave the typical exposure of red loam on a heavy compact red subsoil. The middle pits showed rather more silt than clay and the subsoil was brown-red as opposed to bright red. The bottom pits had a sticky black top soil on a greyish yellow sand.

These soils are formed on the same parent rock with the same external climate, the differences being due to change of soil climate induced by topography. From the mapping point of view it is clearly impossible to map these types except as members of one general group. All the profiles are being studied in detail by laboratory methods and until this side of the work is complete, the precise form of grouping possible is not known. This detailed examination is being carried out in collaboration with the Amani Institute.

ESSENTIAL OILS.

At the request of the Imperial Institute samples of oils (from the following plants) were prepared and sent home for valuation. Eight ounce samples were sent.

(1) " Mujaja omunene " (*Ocimum* sp.).
(2) " Kawamala " (*Coleus* sp.).
(3) *Coleus* sp. (Fleshy-leaved).
(4) Geranium (*P. radula*).
(5) Lemon grass.
(6) Patchouli.
(7) Cinnamon leaf.

Relevant extracts from the Imperial Institute reports are given blow.

Plant.	*1931.*	*1932.*
" Mujaja omunene " (*Ocimum* sp.)	This oil does not contain sufficient eugenol to render it of commercial value as a source of this constituent and it seems hardly likely that it would prove profitable to distil in Uganda for export	Might be saleable for soap perfumery at 2s. 6d. per lb.
" Kawamala " (*Coleus sp.*) ...	Unlikely to be of commercial interest.	Would only be marketable at a low price for soap perfumery.
Coleus sp. (*fleshy leaved*) ...	—	We are doubtful if it will be possible to find a place for it on the market.

Plant.	*1931*	*1932*
Geranium ... ... (*Pelargonium radula*).	Not likely to command so high a place as the true geranium oils.	Reports of importers and distillers are rather contradictory but a value of Shs. 8 to Shs. 10 per pound was given by two importers as compared with Shs. 23 for Algerian and Bourbon.
Patchouli	Commercial value similar to that of Java oil.	Commercial value very low and cannot compare with Singapore oil, which is quoted at Shs. 9 per lb.
Lemon-grass	Good quality and price should be up to price of the oil from other parts, *i.e.*, on Dec. 7th, 1931, 1/10½d. per lb.	Good quality, value about 2s. 3d.
Cinnamon-leaf oil ...	—	Value rather less than 2s. 5d. per lb.
Ocimum menthaefolium ...	This oil might realise a low price as a cheap soap perfume but is not attractive and its production in Uganda is not likely to be remunerative.	—
Hoslundia oposita ...	Same as above.	—

It will be seen that in no case is the home report very hopeful of our producing a high-priced oil. The Imperial Institute suggests we should endeavour to obtain *P. graveolens*, for our source of geranium oil, from Reunion or Algeria and Patchouli from Singapore and efforts are being made in this direction.

WATERS AND BOILER-SCALE.

Three samples of sludge and boiler-scale were examined for the Kampala water supply. They were found to contain a high percentage of oil and combustible matter, showing that the oil separator was not working efficiently; advice was given accordingly.

In addition, carbon estimations were carried out on a number of swamp-waters for the Entomological section in connection with breeding places of mosquitos.

FERTILISERS.

Among the fertilisers examined were three samples of fish manure prepared at Butiaba.—

Method of preparation.	Nitrogen %.	P_2O_5%.	K_2O%.	Moisture.
1. Whole fish roasted and ground ...	9·5 ...	5·7 ...	1·3 ...	14·5.
2. Head, bones and offal; oil extracted	9·0 ...	3·3 ...	0·6 ...	7·9.
3. Complete fish, oil extracted ...	10·5 ...	2·0 ...	0·6 ...	8·9.

Should a fishing industry ever materialise around Lake Albert, No. 2 fertiliser would be a by-product which should find a ready market locally, having a Nitrogen content of nearly half that of Ammonium Sulphate and a small percentage of Phosphate in addition.

LIMESTONES.

Four local limestones have been examined; the best of them came from within a few miles of Fort Portal. One sample from Teso had been burnt, and another burnt and slaked.

Sample.	Insoluble Residue %.	Fe_2O_3%.	P_2O_5%.	$CaCO_3$%.
Toro ...	0·52 ...	Trace ...	1·21 ...	93·2
Teso ...	25·8 ...	4·85 ...	— ...	62·2
Teso, slaked ...	14·6 ...	22·0 ...	— ...	65·2 (48·3% $Ca(OH_2)$
Teso, burnt ...	14·7 ...	23·7 ...	— ...	91·8 (51·4% CaO)

BERRY BORER.

Two investigations on the effect of moisture on coffee berry-borer (*Stephanoderes*) were undertaken in conjunction with the Entomologist—

(*a*) Critical moisture content of prepared coffee at which the borer could not live.

(*b*) Optimum moisture content of the berry on the tree from the point of view of borer-attack.

In the first case the beetles were enclosed with coffee beans of moisture contents varying from nineteen per cent. to eight per cent. and it was found that the beetles were unable to live in the presence of, or to bore into, beans containing 12·5 per cent. moisture or less.

In the second case bored and unattacked coffee berries were picked separately from trees and sent in sealed jars to the laboratory for moisture determination. Twenty samples in all were determined but the results were inconclusive. In slight infestations the borer preferred the more mature and therefore drier berries but in heavier attacks the berries were bored indiscriminately.

ANNATTO.

Extracts have been made from seeds of Annatto (*Bixa orellana*) to investigate its value as a source of vitamin *A* and handed over to the Medical Department for trial.

FIELD EXPERIMENTS.

The manurial experiments on coffee have been continued with the following treatments:—

A.	Niciphos	240 lbs. per acre.
B.	Superphosphate	2 cwt. „ „
C.	Sulphate of Potash	2 „ „ „
D.	Sulphate of Potash	2 „ „ „
	Niciphos	240 lbs. „ „
E	Sulphate of Potash	2 cwt. „ „
	Superphosphate	2 „ „ „
F.	No treatment.	

Each experiment is a 6 by 6 Latin square and all yields are given as hundredweights of fresh cherry per acre. Again one estate gives a nil yield owing to bud-abortion, and that at Nyakabale is discontinued owing to death of the owner. Mr. T. N. Dalziel.

Rubona Estate (F. D. West, Esq.).

Treatments.	*A*	*B*	*C*	*D*	*E*	*F*	*Mean*	*S.E. M.D.*	*Sig. Diff.*
Yield in cwts. per acre...	54·4	50·0	47·8	57·2	48·8	46·7	50·82	7·4	16·5
Percentage of mean ...	107·0	98·5	94·0	112·6	96·0	92·0	100·0	17·5	32·5

Kahangi Estate (A. S. Watkins. Esq.).

Yield in cwts. per acre...	57·3	48·8	52·0	64·5	55·0	58·8	56·1	1·85	4·12
Percentage of mean ...	102·0	87·0	92·8	115·0	98·1	105·0	100·0	3·3	7·35

Buzirusagama Estate (P. R. Paul. Esq.).

Yield in cwts. per acre...	6·0	4·89	3·2	4·5	5·95	3·29	4·64	1·1	2·45
Percentage of mean ...	129·4	105·4	69·4	97·6	128·2	70·9	100·0	23·7	52·7

By the ' Z ' test there is no significance in any one experiment, but by combining the figures for all three centres the analysis of variance shows that treatment D is significantly better than treatments B, C and F, but the difference between D, A and E are not significant. A further experiment has been started in which Nitrogen alone is applied as one treatment.

CROP RESIDUE EXPERIMENT.

This experiment was designed to show the effects of various native food crops on the yield of the succeeding cotton crop when planted year after year in the same land. The experiment was started in season 1927-28 and in each year the food crop has been planted in the spring rains followed by cotton sown in July. It was thought that the exhaustive effects of the food crops would be reflected in time by the yields of cotton so that a rotation might be planned with the least-exhausting food crop preceding the main economic crop.

The experiment was carried out at Kampala and at Bukalasa in the form of a 5 by 5 Latin square and the food crops selected for trial were sim-sim, maize, beans, ground-nuts and sweet-potatoes. As the experiment has been discontinued the complete yields of cotton are given.

Kampala Plantation.

Mean Yield of Cotton in lbs. per acre.

Season treatment.	Sim-sim.	Maize.	Beans.	Groundnuts.	Sweet potatoes.	Mean.
1927–28	186	118	164	135	—	149
1928–29	565	542	629	515	601	570
1929–30	182	244	271	312	205	243
1930—31	156	178	208	217	212	194
1931—32	143	152	134	141	131	140
1932–33	260	222	306	314	284	277
Totals, 5 Year	1,306	1,338	1,548	1,499	1,433	1,424

Five year totals only were taken for the analysis of variance as no cotton yields are available from the 1927-28 sweet-potato plots. Groundnuts and beans are significantly better than the sim-sim and maize.

Although in this experiment there is no statistical significance in the interaction of treatments and seasons, the yields for all treatments in season 1932-33 were consistently higher than any season except 1928-29 although the land had been cropped continuously during the three seasons intervening.

Bukalasa Plantation.

Mean Yield of Cotton in lbs. per acre.

Season treatment.	Sim-sim.	Maize.	Beans.	Groundnuts.	Sweet Potatoes.	Mean.
1927–28	536	544	580	480	—	535
1928–29	306	305	291	291	332	305
1929–30	67	76	52	68	52	63
1930–31	370	256	284	312	432	321
1931—32	282	250	332	316	308	338
Totals, 3 Year	908	811	907	919	1,072	964

In the analysis of variance seasons 1927-28 and 1929-30 were rejected, the former because of lack of cotton figures on the sweet-potato plots and the latter because the yields are not comparable with other seasons.

In this experiment sweet-potatoes are significantly better than all other treatments but there are no other differences. In this experiment too, the interaction of treatments and seasons is significant.

Although the experiment as a whole has not yielded definite information on the order of merit of the various food crops it may be said that sim-sim and maize are not desirable crops to precede cotton in a rotation and that climate is the main factor in determining cotton yields.

The writer is indebted to Mr. H. R. Hosking for all the statistical analyses mentioned in this section.

TOBACCO EXPERIMENTS.

The picking, curing and grading of tobacco from the large number of small plots constituting the "Latin Square" form of experiment is a matter of great difficulty to the grower engaged in harvesting a large crop. It was therefore decided that the experiments on tobacco fertilisation should take the form of one plot of each treatment at each of a large number of centres.

Unfortunately the planting season was bad and yield figures were obtained from four centres only and the results could not therefore be treated statistically.

Yields are in lbs. of cured leaf per acre.

	Treatment.	*Centres by index number.*			
		1	2	3	4
A.	125 lbs. Sulphate of Ammonia 100 lbs. Double Superphosphate	408	860	795	628
B.	125 lbs. Sulphate of Ammonia 100 lbs. Potassium Sulphate	432	860	721	594
C.	100 lbs. Superphoshate 100 lbs. Sulphate of Potash	408	835	—	642
D.	No treatment	384	819	708	441
E.	125 lbs. Sulphate of Ammonia 100 lbs. Double Superphosphate 100 lbs. Sulphate of Potash	456	877	—	582
F.	125 lbs. Sulphate of Ammonia	—	—	715	—

Three Latin squares were also laid down, but the yield figures are not given. Owing to the bad planting season there were too many blanks for statistical treatment of yields.

W. S. MARTIN,

Agricultural Chemist.

ANNUAL REPORT ON THE GOVERNMENT PLANTATION, KAMPALA, FOR THE YEAR 1932.

I was in charge of the plantation from January to May under the supervision of the Superintendent of Agricultural Education. I proceeded on leave early in June when the management of the plantation was taken over by Mr. Ruck, and later in the year, by Mr. Thomas.

WEATHER.

The total rainfall during the year was 46·59 ins. being a decrease of 9·08 ins. from last years's figure. This represents a decrease of 2·62 ins. from the average for the last twenty years and 2·08 ins. decrease from the average for the last six years.

CROPS.

Coffee.

Plot No. 1.—No fresh planting was carried out in this plot. The hybrids and grafts planted out in 1930 are now well established, but have, for the most part, grown slowly. The rows of *Leucæna glauca* planted every five feet across the contour were cut back five times during the year at a total cost of 29/28 cents. This represents a charge nearly three times the amount of similar operations during 1931. During that year the plants were only cut back three times (as against five times in 1932) indicating that growth had become quicker and the plants had thickened up. The plot is about one acre in area.

Plot No. 3. Arabica Pruning Experiment.—The object of this experiment is to test the value of the three general pruning systems by comparing the yields of cherry picked from similar sub-plots under each pruning system. The plot is approximately one acre in area and is divided into twenty sub-plots. The Arabica trees are spaced 10 feet by 10 feet and were originally planted in August, 1924. Shade is given by Rain trees (*Pithecolobium Saman*) spaced at about 40 feet. Seven sub-plots are pruned on the single stem method (*A*), seven on the Agobiada system (*B*) and six sub-plots on the multiple stem method (*C*). The fruits are picked as they become ripe and are immediately weighed.

The plot was mulched with elephant grass during the dry season at the beginning of the year.

The results to date are as follows:—

Table A.

DATA OF COFFEE PICKED FROM PRUNING EXPERIMENT, PLOT No 3.

From 1927 to 1932.

Method.	Sub-plot No.	1927	1928	1929	1930	1931	1932	Total for last six years.
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
SINGLE STEM ...	1	19·84	11·22	34·41	46·72	124·94	117·00	354·13
"A"	2	20·55	20·78	22·19	104·78	55·00	161·06	384·36
	3	13·80	15·22	23·86	70·72	69·47	139·25	332·32
	4	14·70	32·16	15·91	81·34	79·62	71·53	295·26
	5	13·53	18·06	47·86	90·00	91·94	148·81	410·20
	6	15·56	10·56	65·97	58·44	167·78	209·69	528·00
	7	15·61	23·56	14·28	42·94	144·16	139·25	379·80
Total ...	...	113·59	131·56	224·48	494·94	732·91	986·59	2684·07
AGOBIADA ...	1	14·72	6·91	27·50	75·16	115·00	118·28	357·57
"B"	2	30·88	17·75	61·37	99·22	114·02	110·63	433·87
	3	25·23	18·13	72·81	77·72	188·75	119·25	501·89
	4	20·22	14·31	81·00	90·13	165·81	215·00	586·47
	5	8·06	9·19	51·94	71·87	125·88	188·59	455·53
	6	12·39	8·63	51·84	130·00	177·41	236·81	617·08
	7	11·23	8·56	37·03	78·72	126·50	180·19	442·23
Total ...	...	122·73	83·48	383·49	622 82	1013·37	1168·75	3394·64
MULTIPLE ...	1	7·20	6·41	15·60	59·53	112·53	156·88	358·15
"C"	2	5·58	12·56	23·47	83·34	112·59	115·88	353·42
	3	8·45	17·50	48·39	98·41	144·44	122·88	440·07
	4	3·00	11·78	29·41	104·22	125·97	128·94	403·32
	5	4·44	14·03	47·72	88·86	142·47	103·81	401·33
	6	7·11	13·87	25·48	172·28	220·62	169·13	608·49
Total ...	...	35·78	76·15	190·07	606·64	858·62	797·52	2564·78

For purpose of comparison (there being seven sub-plots under "A" and "B," and only six under "C,") the average yield per sub-plot, under the multiple stem system, has been calculated, and added on the total for the last six years.

A fair estimate is obtained in this way on the supposition that there were seven sub-plots under the multiple stem system. The total yields for " A " and " B " and the revised figure for " C," are appended below:—

Method.	*Total for last 6 years.*
Single Stem " A "	2684·07 lbs.
Agobiada " B "	3394·64 lbs.
Multiple Stem " C "	2992·24 lbs.

Plot No. 4. Coffea Robusta Selections and Pruning Experiment.—Coffee robusta selections were planted up in 1930 spaced 8 ft. by 8 ft. In 1931 a pruning experiment was laid down as outlined in the Economic Botanist's No. 97/8 of April 23rd, 1931.

There are six methods of pruning, in quadruplicate, the methods being briefly as follows:—

A. Single Stem.—In this method every alternate tree was capped at 2 feet, and one sucker allowed to grow up to form the main stem. The other trees in the row were not capped. In all cases, under this method, the trees will be allowed to develop to a height of 5—6 feet, when they will be topped and kept down to that height. Pruning consists of removing all suckers from the main stem, trimming up the lower primaries, and thinning out the secondaries where necessary.

B. Agobiada.—The original stem was bent over and pegged down. This induces suckers to arise from the base of the stem. Three or four of these are selected and trained outwards by the insertion of wooden pegs. The lower primaries of the main stem are removed so as to allow full development of the suckers.

C. Costa Rica Multiple Stem.—The young trees are capped at 18 inches and two suckers are permitted to develop, all others lower down being removed. These two suckers are, as far as possible, trained outwards and allowed to grow and are topped at 18 inches. As a result two more suckers develop, these in turn being capped at 18 inches. There are, therefore, three cappings altogether, which should result in a tree with eight terminal suckers.

D. Modified Costa Rica Method.—This method is identical with the Costa Rica multiple stem system, with the exception that after the last, or third capping only one sucker is allowed to develop. In this method therefore, the final result should produce a tree with only four terminal suckers.

E. Free or Open Multiple Stem.—The young trees are allowed to grow naturally and any suckers up to three or four, arising from the base are trained outwards. If, however, the young trees do not produce suckers naturally, they are cut to about 18 inches, and suckers are thereby induced to develop. In such cases the main stem which has been capped, is trained on the single stem method. This system is similar to the Agobiada method in results, but the original stem is not bent over.

F. Kinawa.—All trees are capped at 18 inches and three uprights are permitted to grow from this point. These are later capped at 18 inches, and two suckers arise from each as a result. These suckers are in turn capped at 18 inches.

Remarks.—Generally speaking the young trees have grown well and have responded to the various pruning methods employed. Most of the multiple stem trees received their second capping by the end of the year by which time the majority of the single stem trees had attained a height of 5—6 feet. There would appear to be no pronounced differences, as yet, between those trees in the single stem lines which were not capped.

The elephant grass mulch applied to the plot in November, 1931, had rotted down by May, 1932, at which time the plot was dug over and planted up with *Canavalia ensiforms.* This crop was dug in as a green manure in September, being followed by a cover of *Crotalaria alata.* In December the *Crotalaria* was pulled up, laid on the surface to act as a mulch, and augmented with elephant grass.

Coffee Planting Experiment.—Plot No. 24. The object of this experiment is to test the value of a number of methods in which coffee may be planted, varying from planting the seed at stake in the field, to keeping the seedlings for twelve months in the nursery beds. The various methods to be employed are given in Table B.

TABLE B.

Treatment Letter.	Treatment.	Number of holes.
A	At stake. Eight seeds per hole. In " ebyai " (banana fibre) pots. Four seeds per pot ...	40
B	Put in field at germination	40
C	Put in field six months from date of sowing	30
	Sown in Nursery 6 ins. apart and transferred to field :—	
D	By forestry method at six months	30
E	By native method at six months	30
F	By forestry method at twelve months	30
G	By native method at twelve months	30
H	As D, cutting taproot	20
I	As E, cutting taproot	20
J	As F, cutting taproot	20
K	As G, cutting taproot	20
	Sown in Nursery 3 ins. apart, transplanted at germination into beds at 8 ins. apart and into field :—	
L	By forestry method at six months after date of sowing	30
M	By native method at six months after date of sowing	30
N	As L, at twelve months	30
O	As M, at twelve months	30
P	As F, too deeply	30
Q	As G, too deeply	20

Lay-out.—The plot consists of 40 rows, with twelve holes to a row, spaced 8 ft. by 8 ft., and the various planting methods chosen at random.

Procedure.—All the seedings had been planted out by August, under the various methods detailed above. It was evident by the end of the year that letter treatment " A " (seed planted at stake) was a complete failure. In December 1931 only 7% of the seed under this treatment had germinated. These seedlings did not survive, and although repeated, failure again resulted. In order to avoid a large number of blanks in the plot, the forty holes allotted to letter treatment " A " together with any blanks which had occurred in the other treatments, were planted with extra seedlings from the following letter treatments:—

J. Nos. 39/3, 33/5, 30/10, 27/9, 23/12, 14/1, 12/10, 10/3, 6/1, and 1/11 of Letter Treatment A.

K. Nos. 37/7, 35/11, 31/8, 28/2, 24/4, 16/8, 10/10, 8/6, 5/9, and 2/1 of Letter Treatment A.

N. Nos. 21/3, 4/5, of Letter Treatment B and all blanks of Letter Treatments C and D.

O. All blanks of Letter Treatments E.H. and Nos. 40/3, 37/4 of Letter Treatment I.

P. The remaining six blanks of Letter Treatment I and all blanks of Letter Treatment L and M.

Q. The remaining twenty blanks of Letter Treatment A.

The plot has been undersown with *Crotalaria alata.*

Other Coffee Plots.—A number of coffee grafts raised by the Botanist and which had been planted out in the top part of Plot No. 2 in 1931, were dug up and removed to a newly cleared area adjoining the Eucalyptus clump. This was considered expedient owing to the fact that a main road is planned to run through this plot. The coffee plants were successfully dug up and none were lost through transplanting.

The " No. 9 " Robusta selection growing in Plot No. 7B has again been used as the main supply of seed for distribution and for planting in the nursery.

No special work has been carried out on the other coffee plots but all have been kept in condition and pruned when necessary.

Introduced Citrus Plot (No. 15).—The following imported citrus trees were planted out in May, 1929:—

1. Tahitian Lime (Seedless).
2. Tangerine " Emperor."
3. West Indian Lime.
4. Tangerine.
5. Tangerine " Beauty of Glen Retreat."
6. Orange " Pineapple."
7. Orange " Washington Navel."
8. Orange " Valencia Late."
9. Orange " Du Roy."
10. Orange " Golden Buckeye."
11. Grape fruit " Marsh's Seedless."
12. Grape fruit " Marsh's Seedless."
13. Grape fruit " Royal."
14. Tangerine.

The trees have remained in a healthy condition throughout the year, and the cover crop of *Centrosema pubescens* has been maintained.

Essential Oil Plants.—The following essential oil plants have been grown on the plantation during the year:—

Pelargonium radula, Cymbopogon citratus, Pogostemon patchouly, Ocimum spp., *Coleus* spp., *Hoslundia opposita, Pelargonium* sp. var. Attar of Roses, *Pelargonium capitatum, Pelargonium pinnatum, Pelargonium odoratissimum, Mentha viridis, Mentha aquatica, Mentha piperita, Lippia citriodora, Lavendula vera, Lavendula spica, Rosmarinus officinalis, Thymus vulgaris, Reseda odorata* and *Pelargonium fragrans.*

Hydnocarpus Wightiana.—Plot No 19. Further observations on this plot have revealed that 38 per cent. of the trees are female, 46 per cent male, the remainder not yet having produced flowers. Most of the trees have grown well, and the first fruits ripened during the beginning of the year. The individual yields are given below:—

Tree No.	*No. of fruits Collected.*	*Tree No.*	*No. of fruits Collected.*	*Tree No.*	*No. of fruits Collected.*	*Tree No.*	*No. of fruits Collected.*
2	2	46	1	99	10	154	53
7	388	47	21	105	19	159	167
9	35	50	128	107	55	160	130
11	233	57	48	109	30	164	26
15	76	71	2	111	45	170	30
19	13	72	38	121	119	171	102
25	31	73	82	122	87	177	407
28	43	75	76	127	127	179	62
29	30	78	17	128	285	186	89
32	29	79	2	130	9	188	4
34	12	82	3	133	101	193	3
41	26	83	5	145	186	195	90
42	24	84	102	146	13	202	86
43	98	96	38	151	252		

Hydnocarpus anthelmintica.—Plot No. 11A. No flowers have yet been produced on any of the trees in this plot. The trees have grown taller during the year and are in healthy condition. Green manures have been dug in twice (Buckwheat and *Canavalia ensiformis*).

Miscellaneous Plants and Crops.

Date Palms.—The four date palms (two Siwi and two Amhat date) planted out in July, 1931, have grown very slowly.

Dillenia Indica.—The growth of these trees in nearly every case has been satisfactory, especially the three specimens planted out near the store.

Niger Oil (*Guizotia* sp.).—This plant has been found to grow very well and has been used as a green manure on the plantation. Germination of the seed is excellent and a thick growth of green material is produced in a very short space of time.

Sugar Cane.—Most of this has now been dug out, but a few specimens of the more important P.O.J. varieties have been kept, should it be necessary to increase the supply at any future date.

Fibres.—Small areas of *Boehmeria nivea*, Flax, Jute, and *Asclepias semilunata* have been maintained throughout the year. Preliminary tests on extracting the fibre from *Boehmeria nivea* were carried out by the Agricultural Chemist.

Nursery.

The usual routine work has been carried on in the nursery, consisting chiefly of the raising of coffee plants and fruit trees for distribution purposes.

The following plants and seeds were distributed during the year:—

	Coffea robusta.		*Coffea arabica.*		*Fruit Trees and various economic plants and seeds.*		*Tea Seed.*
	Plants.	*Seeds.*	*Plants.*	*Seeds.*			
To Natives ...	4,136	—	1,080	—	72	—	¼ lb.
To School Gardens	206	—	252	—	68	7 lbs.	—
To Officials ...	650	273 lbs.	—	—	128	—	—
To Others ...	650	10 lbs.	—	—	951	—	531 lbs.

	Green manure.	*Gliricidia maculata.*	*Various Decorative*		*Grasses*
	Seeds	*Poles*	*Plants.*	*Cuttings.*	*Roots.*
To Natives ...	—	—	—	—	—
To School Gardens ...	69¾ lbs.	—	491	—	300
To Officials ...	99 lbs.	500	200	1,053	—
To Others ...	75 lbs.	50	48	244	—

R. W. STUCKEY,
Agricultural Officer.

List of Circulars obtainable from the Director of Agriculture, Entebbe:-

3. DISEASES OF *HEVEA BRASILIENSIS* IN UGANDA.
4. DIEBACK OF *COFFEA ARABICA* IN UGANDA.
7. REPORT ON COFFEE CULTIVATION IN UGANDA.
14. *COFFEA ROBUSTA* IN UGANDA.
15. CULTIVATION AND PREPARATION OF *COFFEA ROBUSTA*.
16. COTTON EXPERIMENTS 1925—1926.
17. (A) THE OCCURRENCE OF ANGULAR LEAF-SPOT OF COTTON IN UGANDA.
    (B) ROT OF *HEVEA CORTEX* IN UGANDA.
19. SUGAR CANE IN UGANDA.
20. NOTES ON THE CULTIVATION, CURING AND PACKING OF FIRE-CURED TOBACCO.
21. SOIL MANAGEMENT AND MANURING.